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WASTEWATER MANAGEMENT STUDY FOR CLEVELAND - AKRON METROPOLITAN --ETC(U)

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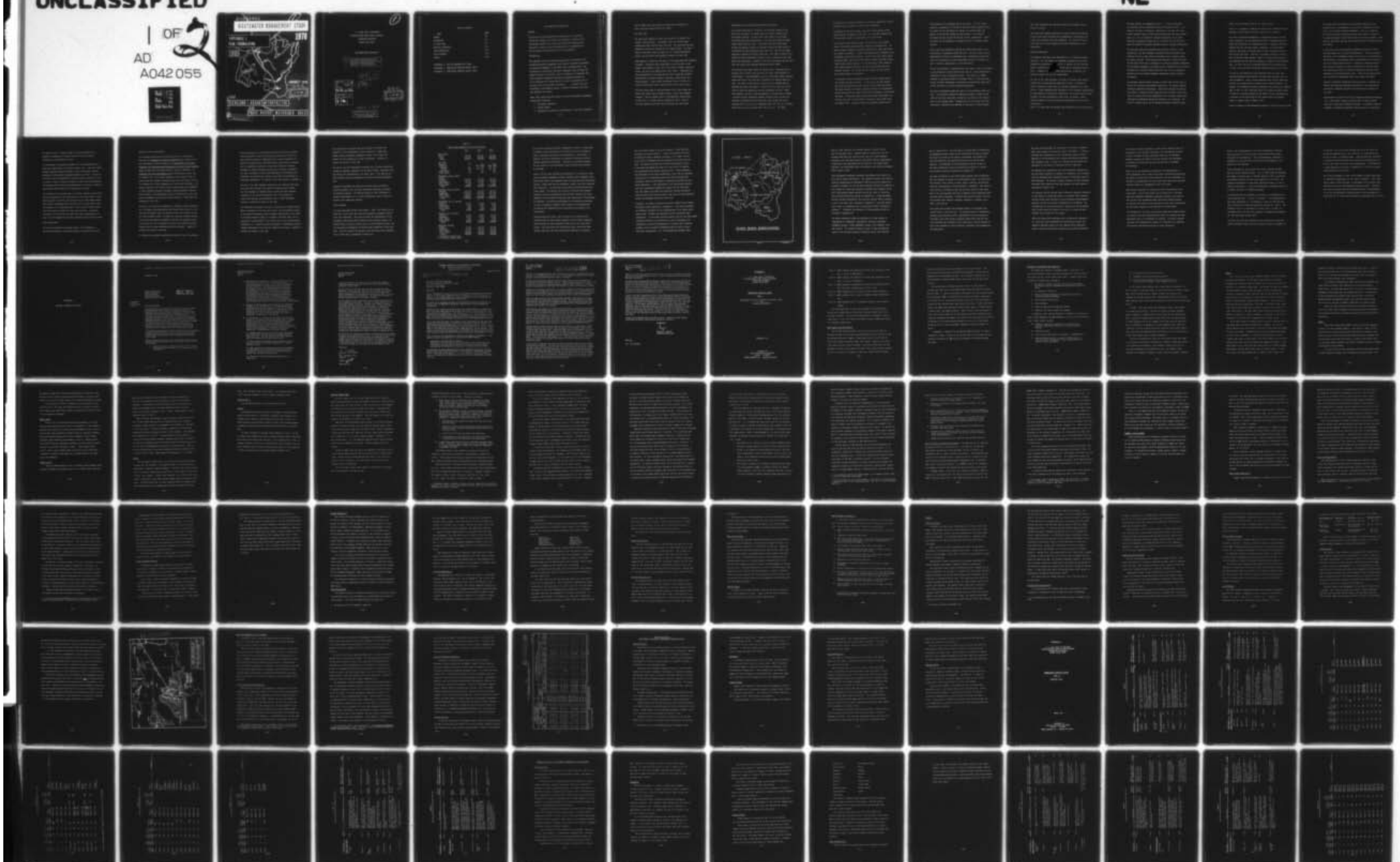

# WASTEWATER M

## APPENDIX I
## PLAN FORMULATION

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U. S. ARMY CORPS OF ENGINEERS

CLEVELAND-AKRON THREE RIVERS WATERSHED

WASTEWATER MANAGEMENT

SURVEY SCOPE STUDY

# PLAN FORMULATION METHODOLOGY

6 Wastewater Management Study for Cleveland - Akron Metropolitan and Three Rivers Watershed Areas. Appendix I. Plan Formulation.

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# PLAN FORMULATION METHODOLOGY

## PURPOSE

The purpose of plan formulation and evaluation is to logically develop the process to be used in the systematic analysis of all practicable solutions to a particular problem and analyze these solutions to arrive at the best possible set of alternatives to meet the goals and objectives set out in the problem.

## INTRODUCTION

This appendix traces the process through which an ultimate set of optimized wastewater management plans evolved to address the problem of wastewater management in the Three Rivers Watershed Area. The formulation of alternative wastewater management plans followed the guidance issued by the Office, Chief of Engineers on 8 November 1971, which specified "alternative wastewater management programs are to be considered the primary vehicle by which contributions are to be made to the four specified components" . . . "national economic development, environmental quality, regional development and social and community well being."

Three steps constituted the process by which the wastewater management systems were formulated:

1. Information gathering.
2. Systems design.
3. Evaluation of systems for contributions to the four components.

Each of these steps was carried on continuously throughout the study, and each interacted with the others.

THE STUDY AREA

The study area consists of three river systems: the Chagrin, the Cuyahoga, and the Rocky. In addition, there are several small streams that drain directly into Lake Erie. The study area was also extended to the west to include all of Cuyahoga County. The headwaters of the main rivers lie along the St. Lawrence-Mississippi divide, and the rivers flow generally northward to Lake Erie.

Approximately 23 percent of the area's 1,500 square miles are presently urbanized. Cleveland, with a population of over 750,000, is the largest urban center in Ohio, one of the nation's largest industrial cities, and one of the largest Great Lakes' ports. Industrial products manufactured in the area include steel, automotive products, machine tools, petroleum products, chemicals, rubber goods, and wearing apparel. Akron, with a population of over 275,000, is a major tire and rubber center and the fifth largest city in Ohio.

The Rocky River Basin is the westernmost of the three rivers and drains 294 square miles in Medina, Summit, Lorain, and Cuyahoga Counties. The two branches join at North Olmstead, flowing north to Lake Erie in a single narrow, steepwalled valley. Most of the East Branch and the main stem flow through the Rocky River

Reservation of the Cleveland Metropolitan Park System.

The Chagrin River Basin is located in the northeast portion of the basin area and drains 267 square miles in Cuyahoga, Geauga, Lake, and Portage Counties. The main river rises south of the village of Chardon and flows southwesterly to its confluence with the Aurora Branch coming from the south. From there, the river flows north through the easterly suburbs of Cleveland joining the east branch of the Chagrin and then discharging into Lake Erie. Much of the upland watershed is generally rolling wooded land. The lower 25 miles of the channel is deeply entrenched on bedrock until it emerges on the flood plain below Willoughby. Sections of the lower east branch and the main stem flow through the Cleveland metropolitan Park System.

The Cuyahoga River Basin drains 813 square miles. Beginning east of Chardon, only 16 miles from Lake Erie, the river flows southerly to Lake Rockwell. This impoundment, used for Akron water supply, severely limits the flow of the river and in extremely dry weather permits no flow. The river at that time may consist only of leakages and the drainage from small tributaries. Authority for the total use of the river by Akron was granted by the Ohio legislature in 1911. Below Lake Rockwell, the river flows southwesterly to Akron where it begins a northerly course through the greater Cleveland area to Lake Erie. Principal tributaries and the areas they drain include the Little Cuyahoga River (68.9 sq. mi.), Breakneck Creek (79.0 sq. mi.), Tinkers Creek (96.4 sq. mi.), and Big Creek (38.6 sq. mi.). The lower

six miles of the Cuyahoga constitute a navigation channel with special problems that are inherent in its use and maintenance.

In addition to the major rivers, there are several smaller stream basins directly tributary to Lake Erie. The combined drainage area of these minor creeks is approximately 133 square miles.

In the Three Rivers Watershed area, the topography of the upland areas of the river basins generally consists of rolling hills. The area is largely wooded and contains numerous small lakes and swamps. The terrain is variable. In some areas streams are of moderate slope and meander through broad valleys. As the rivers pass highly industrialized areas, they often follow complex systems of buried valleys formed during glacial melting. For the most part, soils formed on this glacial material have silt and clay loam textures with slow internal drainage. The coarser sand and gravels of flood plains and glacial outwash occur locally.

A relatively distinct escarpment divides the basin between and upland plateau and the lake plain. In the plain, the main streams are deeply entrenched and steep, and the valley floors are narrow. The lower courses of the Rocky and Chagrin Rivers are in deepsided narrow valleys while the lower course of the Cuyahoga is flat-floored and wider. Pleistocene lakes once occupied these lower areas, and the silt laid down in these lakes is exposed at many places along the valley walls. Erosion of these silt deposits contributes in

large measure to the sediment load of the rivers. The 1970 census reported a population of 2,746,845 in the Three Rivers Watershed Area; 62 percent of that population was located in Cuyahoga County and another 20 percent was located in Summit County. The cities of Cleveland and Akron housed 750,903 and 275,425, respectively. Nearly 80 percent of the population is presently served by sanitary sewage systems.

Recent years have witnessed a gradual but significant change in the distribution of population within the area. Like most older, heavily industrialized cities in northeastern Ohio, Cleveland and Akron have been losing population to their surrounding suburbs, at rates of 14.3 and 5.1 percent, respectively, in the last decade.

The net out-migration of population from the central cities is reflected in the absorption of rural land by urban uses at a rate substantially exceeding the rate of population growth. The result is a general lowering of population density in the inner cities. At the same time, current suburban development is occurring at substantially lower densities than those of earlier suburban developments.

The area's urbanization takes the form of a multi-centered urban network. The principal centers are downtown Cleveland, located on the shore of Lake Erie, and Akron, located on the divide at the southern edge of the Cuyahoga Basin. Although both of the centers have been declining in population and somewhat in influence in recent decades,

they still constitute the principal cultural and economic centers within the region.

Rural land uses consist principally of general farming and dairying. In some areas these activities are supplemented by specialized production that includes fruit and vegetables. The extent of agricultural land use has been declining with rapid urbanization of the countryside.

TECHNICAL OBJECTIVES

Two technical objectives were identified in the 8 November guidance. They were: (1) "to prevent the continued degradation of our water resources by waterborne wastes and (2) to provide for the efficient reuse of treated or renovated wastewater and its separated constituents." Examples of these included agricultural, industrial, and municipal supply, and low flow augmentation.

In light of the first objective, two sets of effluent water quality criteria were established and identified as Level I and Level II. Level I criteria are based upon the effluent standards of the State of Ohio. Those standards allow variations in the effluent concentrations of some indices of pollution as functions of the receiving water classification, dilution availability, plant size, and season. Level I criteria consist of the most stringent requirement for each of those constituents.

Level II is based upon the national goal identified in the Federal Water

Pollution Control Act Amendments of 1972, "... that the discharge of pollutants into the navigable waters be eliminated by 1985." The Office of the Chief of Engineers, Department of the Army (OCE) established technical goals for this study commensurate with that national goal, i.e., (1) to prevent the continued degradation of our water resources by waterborne wastes and (2) to provide for the efficient reuse of treated or renovated wastewater and its separated constituents.

The technical goals were translated into effluent criteria by OCE, consisting of the most stringent constituent levels from among those required for public water supply, irrigation water, livestock water, and aquatic habitat. Those criteria are referred to as the OCE Goals. The OCE Goals should not be interpreted as effluent standards established by the Federal government, but rather are the translation by the Corps of Engineers of the stated national objective into a set of consistent guidelines for all similar wastewater management studies throughout the nation.

The effluent criteria making up Level II differ from the OCE Goals to reflect the continuous performance capability of the various advanced wastewater treatment technologies. Although the treatment facilities are capable of meeting the OCE Goals more than 90 percent of the time, Level II criteria can be met essentially all of the time, barring any unforeseen circumstances having low probability of occurrence. The Level II criteria add to the OCE Goals the parameter, Chemical Oxygen

Demand, with an effluent level not to exceed 10 mg/l.

Table II-1, Attachment C itemizes the State of Ohio proposed effluent standards, the OCE Goals, and Level I and Level II criteria.

The reuse of renovated wastewater as a supplemental supply for municipal, industrial, or even agricultural supply is dependent upon the demand and availability of competitive sources. Presently, Lake Erie, together with the principal rivers, reservoirs, and inland lakes, assures a vast supply of surface water to most localities including many in the study area. Lake Erie, for example, supplies a total of some 23 municipal water systems. About 2.7 billion gallons per day are withdrawn from the Lake for residential, commercial and industrial uses. In 1969, the city of Cleveland delivered 132 billion gallons of water to the more than two million population served by its system.

In spite of the abundance of water available from Lake Erie, some upstream communities have elected to develop water supplies from tributary headwaters. Many of those communities must develop additional supplies in the near future in order to meet projected demands. For example, the Northeast Ohio Water Development Plan includes the development by 1980 of a well field near Burton to increase the water supply to Akron by 44 million gallons per day (MGD), and the construction of a reservoir on the West Branch of the Cuyahoga River to increase supply to Geauga County by almost 16 MGD.

Akron is expected to need additional supplies of 40 MGD by the year 2000.

This supply could be provided by an additional reservoir on the Cuyahoga River, by development of a well field, transport from Lake Erie, or by recycling renovated wastewater. There is a potential use conflict because the reservoir option would affect a section of the proposed National Scenic River system on the upper Cuyahoga. Other upstream communities may meet their future needs by improving existing well fields.

It should be noted that wastewater treatment and recycle of water and constituents can be achieved simultaneously. The land treatment technology is an outstanding example; the recycle of the nutrients to the vegetation is coincidental with the improvement of the quality of the water passing through the soil. Similarly, industrial recycle after partial treatment or reuse of wastewater in other processes can significantly reduce the volume of wastewater requiring final treatment to the desired quality level. These recycle opportunities were specified for examination within the scope of the study.

Recycle of separated constituents can be achieved by utilizing the sludges from municipal treatment facilities as a soil conditioner, and specific attention was given to exploiting that potential in the study.

Consideration was given to the use of certain industrial wastewaters (i.e., spent pickle liquors) as substitutes for some treatment chemicals in municipal treatment facilities. In addition, combined treatment of industrial wastewaters which may react to neutralize

the effect of both, or which because of their similarity may be treated in combination to reduce treatment costs and resource consumption, was specified for study.

The utilization of renovated wastewater for flow augmentation was of particular significance in the lower Cuyahoga River. The river valley between Cleveland and Akron provides a major recreational resource accessible to the densely populated metropolitan complex. During the mid-1960's the Ohio Department of Natural Resources conducted a study to develop a plan to utilize the valley for open space and recreation. Ten thousand acres of land are already owned by the Akron or Cleveland Metropolitan Park Districts or by quasi-public agencies.

The provision of high quality water in adequate quantity in that river reach can contribute to the value and use of that park system. Since, during periods of low flow, the effluent from the Akron sewage treatment facility constitutes about two-thirds of the lower river's flow, the assurance of a continuous supply of high quality renovated water from that facility provides for reuse for recreation. Conversely, diversion of that flow from the lower river would significantly detract from the potential water-based recreation within the park system.

## STUDY ORGANIZATION

The study was divided into component tasks, each performed by a specialized consultant, which were combined to accomplish the steps

identified in the Introduction.

Two documents constituted the principal sources of current data. They were the Northeast Ohio Water Development Plan, produced by the Ohio Department of Natural Resources and Alternatives for Managing Wastewater for Cleveland-Akron Metropolitan and Three Rivers Watershed Areas, published by the Buffalo District, Corps of Engineers. The Northeast Ohio Water Development Plan was distributed in draft form in November 1971. That report considered a wide range of water resource needs and problems, including water pollution control, for all of northeast Ohio, which encompasses the Three Rivers Watershed. The report published by the Buffalo District demonstrated the feasibility of using advanced biological treatment, physical-chemical treatment, land treatment, and combinations of those technologies for the treatment of wastewater from the Three Rivers Watershed. That report was published in July 1971.

The task of the municipal wastewater and stormwater runoff consultant was to estimate from existing data and current study reports the present and anticipated flows and pollutant loads from domestic sources and from stormwater runoff, to design all municipal advanced biological and physical-chemical treatment facilities and stormwater treatment facilities, and to estimate the capital and operation and maintenance costs of those components which were designed. Appendix III contains the report of this task.

The industrial wastewater consultant was given the task of estimating

from existing data the current and anticipated industrial wastewater flows and pollution loads, identifying the proportion of that flow which could be treated in combination with domestic wastewater in a municipal treatment plant, designing typical facilities for pretreatment of wastewaters discharged to municipal systems and complete treatment of those discharged directly into a waterway, estimating the cost to industry to treat those wastewaters, and estimating the proportion of the municipal treatment costs which are attributed to industrial wastewaters. The report of that task appears in Appendix IV.

The task of the land treatment consultant was to identify land areas within the Ohio portion of the Lake Erie drainage basin suitable for land treatment of treated effluent, design the land treatment components of the various alternative plans, and estimate the capital and operation and maintenance costs of those components. Appendix V contains the report of that task.

The evaluation consultant's task was to determine the current environmental conditions in the study area, assess the environmental impacts of the various alternative plans, recommend modifications to any plans to eliminate negative impacts or to enhance beneficial ones, and to evaluate the contributions of the various plans to the four specified components, i.e., national economic development, environmental quality, regional development, and social and community well-being. Appendix VI contains the report of that task.

The institutional evaluation task was intended to determine the capability of the governments and their agencies to finance and manage regional wastewater management systems, and to assess the impacts of each alternative on those institutions. Appendix VII reports the results of that task.

The task of the plan formulation consultant was to develop alternative systems for managing wastewater for the entire region, integrating into that effort the contributions of all other tasks. This task and the land treatment task were performed by the same consulting engineering firm.

Conceptual formulation was shared by all task groups and Buffalo District personnel, with the plan formulation consultant performing the detailed planning. The technical report of that consultant is attached (Attachments B & C) to this introductory report to form the complete Plan Formulation Appendix.

STUDY PROCEDURE

The study progressed through three phases. Phase I was devoted to the collection of the basic data from which wastewater managment alternatives were formulated. This phase included the determination of the wastewater flows and pollution loads from the principal sources, the identification of areas of soils suited to land treatment effluent, and the background environmental and institutional conditions in the study area. Specific chapters are devoted to the description and interpretation of these data in Appendices II through VII.

TABLE M-1

WASTE LOADS GENERATED WITHIN THE STUDY AREA

| | 1970 | 1990 | | 2020 | |
|---|---|---|---|---|---|
| AREA (ACRES) | | | | | |
| Urban | 225,000 | 416,200 | | 499,100 | |
| Rural | 739,400 | 548,200 | | 465,300 | |
| TOTAL | 964,400 | 964,400 | | 964,400 | |
| FLOW (MGD) | | | | | |
| Domestic | 313 | 463 | | 628 | |
| Industrial | | *MIN | **MAX | *MIN | **MAX |
| Process | 163 | 115 | 197 | 143 | 243 |
| Cooling | 520 | 177 | 579 | 191 | 682 |
| Urban Runoff | 97 | 171 | | 224 | |
| Rural Runoff | 216 | 160 | | 136 | |
| BIOCHEMICAL OXYGEN DEMAND (LB/DAY) | | | | | |
| Domestic | 335,290 | 519,180 | | 685,250 | |
| Industrial | 305,760 | 327,510 | | 367,870 | |
| Urban Runoff | 26,190 | 37,130 | | 52,530 | |
| Rural Runoff | 5,840 | 4,330 | | 3,670 | |
| TOTAL | 673,080 | 888,150 | | 1,109,320 | |
| SUSPENDED SOLIDS (LB/DAY) | | | | | |
| Domestic | 470,920 | 672,830 | | 846,610 | |
| Industrial | 2,360,040 | 2,747,010 | | 3,121,130 | |
| Urban Runoff | 199,420 | 382,940 | | 577,370 | |
| Rural Runoff | 368,610 | 273,290 | | 232,020 | |
| TOTAL | 3,398,990 | 4,076,070 | | 4,777,130 | |
| PHOSPHOROUS (AS P) (LB/DAY) | | | | | |
| Domestic | 25,100 | 35,700 | | 43,370 | |
| Industrial | 4,380 | 4,930 | | 5,260 | |
| Urban Runoff | 2,880 | 3,400 | | 3,950 | |
| Rural Runoff | 360 | 270 | | 220 | |
| TOTAL | 32,720 | 44,300 | | 52,800 | |
| NITROGEN (AS N) (LB/DAY) | | | | | |
| Domestic | 52,580 | 74,800 | | 92,480 | |
| Industrial | 17,840 | 19,870 | | 22,440 | |
| Urban Runoff | 5,230 | 7,150 | | 8,910 | |
| Rural Runoff | 3,590 | 2,660 | | 2,270 | |
| TOTAL | 79,240 | 104,480 | | 126,100 | |
| CHLORIDES (LB/DAY) | | | | | |
| Domestic | 71,730 | 110,420 | | 141,710 | |
| Industrial | 92,420 | 109,050 | | 123,850 | |
| Urban Runoff | 111,160 | 194,270 | | 295,400 | |
| Rural Runoff | 107,900 | 80,010 | | 67,900 | |
| TOTAL | 383,210 | 493,750 | | 628,860 | |

* Projecting Maximum Reuse
** Projecting Nominal Reuse

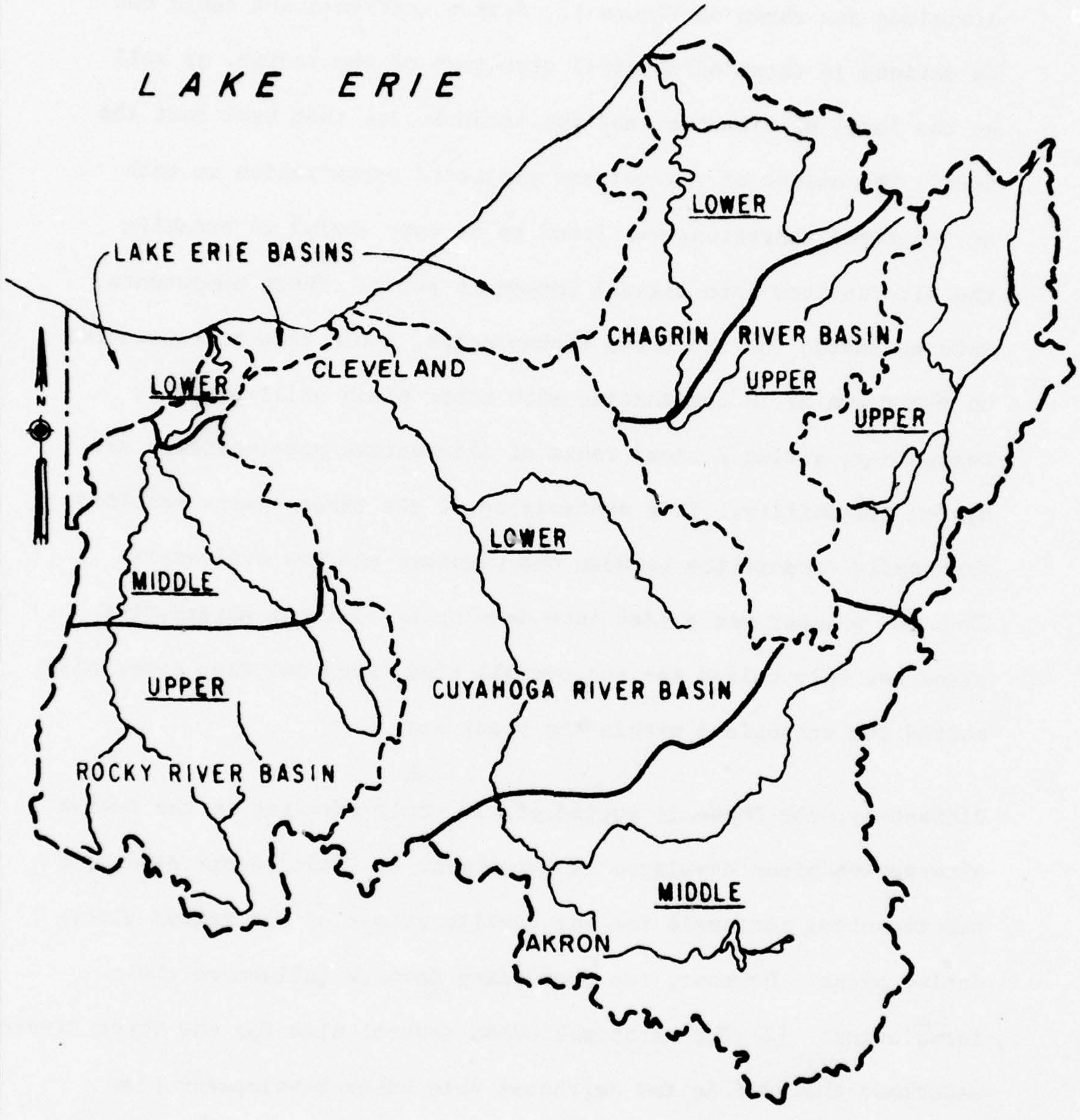
The flow and pollution load data, summarized in Table M-1, demonstrate a decrease in the contribution of pollutants from rural stormwater runoff, resulting principally from urbanization of rural lands. In addition, the rural contribution is expected to decrease as better farming practices are developed. Therefore, no structural measures for the control of rural stormwater runoff pollution were included in the study.

Phase II of the study included the formulation of a spectrum of alternative wastewater management systems, designing their components, estimating their costs, and evaluating their environmental and institutional impacts. These steps were not sequential; rather, they were concurrent and interactive. All consultants participated throughout this formulation phase. For example, the stormwater collection and treatment systems in the first alternative plan developed reflected the recommendation of the evaluation consultant that disturbance of flow regimes be minimized. The priority established by the evaluation consultant for use of wastewater treatment plant sludges for stripmined land restoration and revegetation was incorporated into several of the alternatives.

Analysis during the Phase I and II portion of the overall study indicated that the study region appeared to have distinct characteristics related to three subregions within each of the Three River basins. Thus the basins were divided into upper, middle and lower regions based upon land use and population densities as projected

over the period covered in the study analysis. These basin subdivisions are shown on Figure 1. System configuration could now be defined in terms of physical structure of the region, as well as the level of treatment and the technologies that best meet the need. The amount of percent and projected urbanization in each of the three subregions was found to be very useful in breaking the alternatives into logical component parts. These components, when optimized for the three technologies, could then be considered on their own or in combination with other plans utilizing that technology, giving a broad range of alternative possibilities and system flexibility. This subdivision of the three basins resulted from early cooperation between the planners and the evaluators. Thus the planner was guided into developing flexible alternative plans not only suited for the overall study area but also especially suited for subregions within the study area.

Ultimately, the Phase II period of the study resulted in the twelve alternative plans displayed in Attachment B. That report discusses the technical rationale for the configurations of the twelve alternative plans. However, two overriding factors influenced their formulation: (1) The water pollution control plan for the Three Rivers Watershed included in the Northeast Ohio Water Development Plan represented a practical demonstration of regional water resources planning, and it provided a substantial base on which to build additional alternatives. (2) The International Boundary Water




## RIVER BASIN SUBDIVISIONS



FIGURE 1

Treaty of 1909 prohibits the ultimate transfer of water from the Lake Erie Drainage Basin. Although areas lay outside the Lake Erie Drainage which were well suited for the use of the land treatment technology, the feasibility study by the Buffalo District demonstrated a significant cost associated with the return of the treated water. Therefore, the alternatives were all confined to the Lake Erie Drainage Basin portion of Ohio.

Three fundamental wastewater treatment technologies were included in the array of twelve alternatives. The advanced biological and physical-chemical technologies are discussed in detail and typical designs are included in Appendix III and the land treatment technology in Appendix V. Five options for industrial wastewater treatment were examined, one of which incorporated maximum internal recycle and reuse by industries. Their detailed description appears in Appendix IV. Sludge management options included incineration, the principal disposal method currently in use in the study area, discussed in Appendix III, and land application, either to stripmined lands or agricultural lands, discussed in Appendix V. Collection and treatment of urban stormwater runoff is discussed in Appendix III.

The twelve alternative plans are comprised of a large variety of combinations of fundamental technologies, industrial wastewater management options, sludge management options, and stormwater treatment options. The technical details to each of those alternatives appear in the attached technical formulation report, and therefore

are not repeated here. The wide range of combinations of technologies and management options making up the alternatives provided an equally wide range of impacts on the region's environment, and thereby provided for maximizing the beneficial impacts of the various plan features. The assessment of the environmental impacts of each of the twelve alternative plans are identified in Appendix VI and the institutional impacts are discussed in Appendix VII.

Two areas in addition to the Three Rivers Watershed were incorporated into the features of several of the alternative plans. The first area was located at the junction of Huron, Seneca, Crawford, and Richland Counties, approximately 70 miles southwest of Cleveland. That agricultural area was sufficient in size and had soils suited to land treatment of all the wastewater and urban stormwater runoff generated within the Three Rivers Watershed. Principal agricultural products from that area include dairy products, soybeans, vegetables, livestock, corn, wheat, oats, and hay.

The second area included the stripmined region of Appalachian Ohio, located south of the Study Area. The principal area of consideration centered around Harrison County, approximately 90 miles southeast of Cleveland, since there exists a pipeline right-of-way from the Lake Erie shoreline near Eastlake to that county which could be adapted for use in the transport of liquid sludge for stripmined land revegetation and restoration.

Following the development and evaluation of the twelve alternative plans, major emphasis was placed on public involvement. A series of workshops and presentations of the alternatives began with three meetings in the Northcentral Ohio counties identified as potential land treatment areas. A total of 27 meetings was held before the refinement of the plans for continued study was finalized.

The response from Northcentral Ohio was overwhelming opposition to any plan which proposed the transport of wastewater, raw or treated, from the Cleveland-Akron Metropolitan area to Northcentral Ohio for land treatment. Ten specific concerns regarding the land treatment technology were identified from that response, and each concern is discussed in Appendix VIII.

The response from the Harrison County region was generally favorable to the concept of sludge application to stripmined land, although sincere concern about pollution of local waterways and groundwater supplies, as well as bacterial contamination was expressed. The acceptability of sludge application to agricultural and stripmined land in this region was primarily the result of strong and well-informed local support for the concept.

Within the Three Rivers Watershed Area, the principal response to the study came from conservation and environmental groups, who generally expressed support for the planning effort especially since it involved alternative technologies for problem resolution.

The principal concerns expressed by these groups centered around the performance of the systems, regardless of the technologies included in them, to produce effluent quality for which they are designed. Frequent citations were made to the poor operation and maintenance of existing facilities and the resulting decrease in treatment effectiveness.

Phase III of plan formulation consisted of the reformulation of three alternative plans, based on the twelve preliminary alternatives, the design of those plans, their evaluation, and the development of a schedule of implementation for each which would comply with the Water Pollution Control Act Amendments of 1972 (PL 92-500).

Many factors influenced the concepts and the configurations of the final plans. One of these factors was the objective of providing bona fide alternative wastewater management systems to the State of Ohio and the local governments based upon their existing systems. In addition, the results of the evaluation of the twelve alternatives and the public response to them affected the reformulation.

The evaluation of the twelve alternatives identified numerous beneficial impacts from plan components which should be exploited and many detrimental ones to be eliminated if possible. The public response was taken into consideration; however, no technology was eliminated from further consideration because of public opposition.

Finally, the recommendations of the Ohio Environmental Protection Agency regarding the preferred plan configurations significantly influenced the reformulation. Those recommendations, appearing in Attachment A, were made after the review by OEPA personnel at the series of public meetings.

Three configurations were selected for further formulation based upon the factors identified above. Each of those plans was developed and phased to achieve Level II effluent quality by 1985, to approach the national objective for that year identified in PL 92-500. The technical description of those plans, designated Plans A, B, and C, appear in Attachment C. (Plan A was subsequently designated Plan A-II, to specify the level of treatment achieved).

An additional plan was formulated specifically to differentiate between achieving Level I or Level II treatment. The configuration of that plan, designated A-I, is identical to Plan A-II, and the technical description of that plan appears in Appendix III, Part 3. The phasing of Plan A-I is scheduled to achieve Level I by 1983, in accordance with PL 92-500, with expansions programmed to accommodate the flow anticipated through 2020.

The final four plans were evaluated in the same manner as were the twelve alternative plans, and that evaluation appears in Appendix VI.

In addition, four final public hearings were held, two within the Three Rivers Watershed Area, one in Willard, in Northcentral Ohio, and one in Cadiz, in Harrison County. These meetings were conducted to inform the publics affected by any plan of the alternatives provided to the State of Ohio for their consideration. The transcripts of these meetings are reported in Appendix VIII, as are the written communications from the public.

Any further refinement of plans, or an attempt to select among them, is considered inappropriate for the Corps of Engineers. That choice must be made by local officials, in compliance with the basin plans identified by the Ohio Environmental Protection Agency. Therefore, this report concludes with four alternative plans for consideration by the Ohio Environmental Protection Agency in the development of a basin plan for the Three Rivers Watershed in compliance with PL 92-500.

ATTACHMENT A

OHIO-EPA, DECEMBER 1972 LETTER

State of Ohi 'vironmental Protection Agency, Box 118, 450 E--- Town Street Columbus, Ohio 43216 (614) 469-3543

December 5, 1972

Colonel Robert Moore
Corps of Engineers
Buffalo District
1776 Niagara Street
Buffalo, New York 14207

OhioEPA

John J. Gilligan
Governor
Dr. Ira L. Whitman
Director

Dear Colonel Moore:

We have reviewed with considerable interest the waste management alternatives developed as part of the Cuyahoga Wastewater Management Plan. The analysis of environmental effects of each alternative is equally interesting, although I wish it had been possible to specifically relate the alternatives to the environment as well as to each other. Inasmuch as we anticipate utilizing this data to assist in evaluating waste and resource management strategies to be recommended in the state's basin and metropolitan water quality plans, I feel it appropriate to respond to you in terms of our own planning needs as they relate to the subject of your study. You may then find it possible and desirable to expand upon the data presented in various of the alternatives, to the extent that time and funds are available.

It should also be made clear in the plan that none of the alternative strategies proposed should be carried out by the direct federal implementation or action until proven practical and desirable by suitable demonstration projects in the geographic area covered by the report.

Among our planning needs which could tremendously benefit from the Cuyahoga Wastewater Management Plan, we would particularly include the following:

A. Update the state's Northeast Ohio Water Plan to reflect anticipated federal standards and the treatment of urban storm runoff.

B. Recognizing that disposal of treated wastewater directly into streams and lakes is not necessarily the best resource management strategy, we are greatly interested in cost-effectiveness of disposing treated wastewater and sludge on land. Existing population distribution in the Three Rivers area suggests that land disposal be considered in terms of two strategies: a) maximum local management with disposal of as much wastewater as possible within the basin of origin and exportation of the balance (such as your alternative 7) and, as an interim step, alternative 5, or b) maximum logical regionalization of land disposal such as contemplated in your alternatives 4 and 12, or more practically, alternative 8.

C. Disposal of sewage sludge and fly ash was not seriously broached in the Northeast Plan. Thorough analysis and recommendations on this matter are a must for any waste management alternative considered. Utilization of these resources for strip mine area reclamation should be considered only one of several possibilities since, if successful, "competition" could result.

D. To demonstrate to ourselves and the public the potential utility of the newer strategies discussed above, it seems urgent that several early action demonstration projects be proposed prior to any major implementation works. Demonstration projects should be practical solutions to existing local needs and be compatible potential components of the fully implemented total scheme if they prove successful. Recommendations could well include:

1) Implementation details on several actual communities which could profit by land disposal systems during the next five years. Consider towns in the Upper Cuyahoga and in the potential wastewater export areas.

2) Same approach for demonstration of physical-chemical systems in a small residential community and a mixed industrial city.

3) Same approach for demonstration of sewage sludge/fly ash utilization for strip mine or dense clay area land reclamation. Project should be of operational scope rather than laboratory demonstration.

4) Urban storm runoff treatment demonstration in a large city.

Colonel Robert Moore
December 5, 1972
Page 3

I would also like to note that we are becoming increasingly concerned regarding the wise allocation of the land and energy available to us in Ohio.

We feel it wise to allocate some of these resources to waste treatment. But we are most concerned that ultimate plan studies such as yours consider the break-even points where space and energy requirements for environmental cleanup will begin to worsen rather than improve the environment. The tentative warnings of the KSU evaluation must be thoroughly examined.

Let me suggest several constraints which we feel should apply to all alternatives considered: a) Return of sewage sludge for soil improvement should be costed; b) Total land, energy, chemical and dollar resources should be clearly shown; c) Potential flow regime changes (quantity and quality) should be estimated in detail for each affected stream; d) Legal aspects should be considered including effects on riparian rights vs. reasonable use doctrine, Akron "ownership" of the flows of the Cuyahoga, public expense to benefit private land, etc.; e) Each alternative studied should be related to established stream standards and the plan should show the range of water quality enabled by each alternative as well as presenting estimates of added biotic species anticipated as a result of increasing investment; f) Any acceptable basin plan must include estimated water quality effects of sedimentation and of its control. We cannot adopt any "alternative" until this data is available; g) No alternative or plan is complete until it spells out the methods of implementation from institutional and financial points of view and our acceptance of any alternative would, of course, be geared to this.

My staff will be pleased and available to discuss the above concepts in detail as may seem helpful to you. I do also want to personally recognize and thank you for the wonderfully cooperative and helpful spirit which has developed between our respective planning staffs during the conduct of this study. I am taking the liberty of including a copy of a recent letter from George Watkins because I feel his concerns are well taken and may be helpful to you.

Sincerely,

Ira L Whitman

Ira L. Whitman, Ph.D.
Director

ILW/drh

Enclosure (1)

THREE RIVERS WATERSHED DISTRICT
621 NBTK SUPERIOR BUILDING
CLEVELAND, OHIO 44114
Telephone: 621-1126



November 27, 1972

Dr. Ira L. Whitman, Director
Ohio Environmental Protection Agency
450 East Town Street
Columbus, Ohio 43216

Dear Ira:

It was thoughtful of you to ask me to the State's discussion of the Corps' studies on wastewater management in the District. In response to your request, I am putting down my thoughts at this point in the planning process in which we are involved with the Corps.

It seems to me important to keep our objectives in mind so we do not get carried away by persuasive arguments related only to waste management techniques.

Concerns about liquid waste management have arisen because our waterways and lakes have been used as waste sinks to the point that other uses have been reduced or eliminated. Many adverse effects in our waters have been attributed to pollution from such waste discharges. Some of these effects have had little scientific evidence presented to support the case that such waste discharges were in fact the cause of the noted undesirable effects.

It is beginning to appear, for example, that the decline in the Lake Erie fisheries is related more to reduction in suitable spawning environments and to predatory fishing practice than to waste discharges. This suggests that if one objective is to restore commercial fisheries in the Lake attention to sedimentation instreams, Lake shore erosion, dam elimination, and improved commercial fish management is important and in most areas probably more important than one-sided correction of effluent discharged from pipes.

Thus it was that we started with concern about <u>uses</u> of our waters. Water quality objectives established to meet this concern include:

protection of public water supplies
restoration of fish habitats and fisheries in streams and Lake Erie
restoration of shore waters and streams for water contact sports
restoration of the aesthetic quality of streams and other waters

As planning has gone forward certain other objectives have been derived, particularly those which relate to use of wastes for beneficial purposes wholly apart from water quality. Thus use of sludge as a soil builder and use of nutrients in waste water streams for crop production have been derived.

Another set of objectives has been derived largely from administrative difficulties in translating water uses into waste treatment standards for pipe discharges, namely uniform effluent quality standards.

My principal technical concern with the Corps study is that ITS GOALS are essentially all of the derived variety. The principal exception to this - and a valuable addition to earlier planning studies, ours included, - is their broader examination of techniques for control and treatment of urban runoff.

Because of their goal derivation, it is not possible to determine whether OUR goals will be reached even when we meet their goals. The MSU evaluators, for example, were able only to put into relative terms the impacts on receiving waters of water quality effluents produced by their various alternatives.

Thus it seems to me we need from the Corps specific information so we may judge how well our goals are likely to be met. We need this so the public may determine the best way to balance the very major expenditures they are going to have to make and to have some assurance that the goals they have supported are going to be reached.

Specifically this means to me that there should be a demonstration that the very significant annual expenditure differences between existing planning targets result in significant differences in the quality of the environment we are going to achieve. I would start with the N. E. Ohio Water Development Plan as the base (although we are not at that level of achievement yet, it was designed to achieve the designated uses of our waters) and proceed to the Corps "NEOWDP" level 1 plan and thence to a level 2 plan, such as #7. For comparison to a case with a significant amount of land disposal #8 would do which, at level 2 puts land disposal at its greatest presumed advantage.

In each case we should ask for monthly flow patterns in each river and affected tributary; for evidence that underlies the biological environment in the streams and Lake Erie, including added species anticipated; and for evidence that underlies the aesthetic condition of the streams. Because storm water control and treatment is of such considerable expense, it seems appropriate to make its impacts stand out clearly from the waste water treatment. It could be that the present N. E. Plan with storm water treatment could come closer to our goals than level 1 or level 2 plans with waste treatment alone.

It may well be that the assessments asked for above cannot be made without demonstration projects. It seems likely in any event that the public will not buy either land disposal or storm water treatment without demonstration of their virtues. Thus we should ask the Corps to fund demonstrations of each in such a way that their efficacy may be established in the District. This should include return to the land of entrapped sediments in the storm water treatment. In the meanwhile, proceeding along on the general base of the N. E. Plan will not close the option of subsequent more massive land disposal systems should they prove their merits.

Evaluators indicated such high virtues for strip mine disposal of organic sludge that modifications of the N. E. Plan to include this technique are probably warranted.

To date I have been unable to extract a solid cost comparison between the methods of sludge disposal examined by the Corps; a cost determination, based upon sludges produced by the N. E. Plan, and the N. E. Plan carried to level 1 should be made; if significant changes in the character of sludges produced is anticipated as higher treatment levels are reached, it would be well to make sure such changes do not alter the anticipated beneficial results of strip land disposal.

We discussed the implications of implementation methods and management needs, and Ohio's desire to obtain a clear picture of the Corps thinking at the highest levels as to their future participation in such activity. Looked at broadly this may be the most important issue we must face. To a great degree this is a philosophic question rather than, say, an economic one. If we should decide such an issue in short term apparent economic gains to Ohio and ignore the more far reaching question of appropriate areas of Federal involvement we would in my judgement be missing the really critical issues. I think it of extreme importance to Ohio, to the Country and to the people of each that the Corps be asked to state its own position firmly on this matter and at the top level of the Army.

I hope these comments may be of help to you. Should you wish further discussion on any of these points, please let me know.

Sincerely,

George

George H. Watkins
Secretary-Treasurer

GHW:kop

cc: Art Woldorf

ATTACHMENT B

U. S. ARMY CORPS OF ENGINEERS
CLEVELAND-AKRON THREE RIVERS WATERSHED
WASTEWATER MANAGEMENT
SURVEY SCOPE STUDY

# FORMULATION TECHNICAL REPORT

## PART I

## DEVELOPMENT OF TWELVE ALTERNATIVE REGIONAL PLANS FOR WASTEWATER MANAGEMENT

NOVEMBER 1972

PREPARED BY
WRIGHT-McLAUGHLIN ENGINEERS
DENVER COLORADO

UNDER CONTRACT NO.: DACW49-72-C-0051

Plan 7: NDCP standards and combination of water and land-based treatment -- primarily water-based.

Plan 8: NDCP standards and combination of water and land-based treatment -- primarily land-based.

Plan 9: NDCP standards and combination of water and land-based treatment with major regionalization of facilities.

Plan 10: NDCP standards and all biological (water-based) treatment.

Plan 11: NDCP standards and all physical-chemical (water-based) treatment.

Plan 12: NDCP standards and all land-based treatment, using aerated lagoons.

The formulated plans in each case attempted to take advantage of the particular opportunities that follow from each combination of the principal variables. This also provided patterns of component relationships which, in turn, led towards the identification of additional potential component combinations.

## WATER QUALITY DESIGN CRITERIA

The effluent quality design criteria used are given in Table G-1. The State of Ohio criteria have been determined with participation by the Environmental Protection Agency. These water quality criteria do not specifically apply to separate urban storm runoff. However, for a practical water pollution control program, it has been assumed that any plan designed to these criteria should include at least long-term plain sedimentation, straining for the removal of detritus, floating and settleable

solids, and chlorination for disinfection of urban storm runoff. The settling basins would naturally provide the advantage of stream low-flow augmentation and hydrograph leveling. This treatment, combined with preventive measures, should produce results consistent with the Ohio State criteria.

The second level of effluent quality criteria is based upon the national goal identified in the Federal Water Pollution Control Act Amendments of 1972, "...that the discharge of pollutants into the navigable waters be eliminated by 1985." The Office of the Chief of Engineers, Department of the Army (O.C.E.) established effluent criteria for this study commensurate with that national goal, consisting of the most stringent constituent levels from among those required for public water supply, irrigation water, livestock water, and aquatic habitat. These criteria, which also apply to urban storm runoff, should not be interpreted as effluent standards established by the Federal Government, but rather as the translation by the Corps of Engineers of the stated national objective into a set of consistent guidelines for all similar wastewater management studies throughout the nation.

In Appendix I, wherever the terminology "NDCP Standards" or "Level 2 Standards" is used, it refers to the national goal of eliminating the discharge of pollutants by 1985 and to the effluent criteria which embody that goal.

## RATIONALE OF TREATMENT PLANT SELECTION

The number and location of treatment plants in each plan is a function of numerous criteria that were developed for inclusion during the Formulation part of the Three Rivers Study. In general each plan, in addition to annual cost, considers:

1. Building on existing firm plans and programs to prevent the delay of present implementation plans (where practical only).

2. All sources of pollution.

3. "Best available technology" and engineering projection of best available technology.

4. Non-structural alternatives.

5. Land treatment.

6. Potential apparent environmental impacts.

7. Potential for reuse of water and sludges.

In addition, plant size and location is necessarily a function of State of Ohio Standards, and NDCP Standards, as well as reuse considerations. Other factors include:

8. Potential locations of pollution; i.e. proximity to pollutant sources and flexibility to handle potential sources.

9. Economy of scale.

10. Institutional constraints with respect to implementation.

11. Regionalization not only in terms of "combining" but also in terms of "separating" (localizing problems and solutions where they occur).

11. Utilization of existing facilities.

12. Topography and projected growth patterns.

13. Collection system gravity flow of essentially all of the collected raw sewage to the treatment facility.

For all Plans urban combined storm runoff requires treatment in a facility equal to sanitary sewage, so that where possible, combined stormwater should be detained and released through existing sewers for treatment at sanitary sewage plants. Where special conditions dictated, urban combined storm runoff would be treated at local collection (overflow) points.

In Plan 1 there was concern over degrading several river reaches with sewage plant effluent. For Plans 2 through 12, sewage treatment plants, especially to NDCP criteria, were looked upon as "equalizing" and in some cases "supplementing" stream flows with high quality water. A stream supplement would, for example, be an area served by Lake Erie water discharging to a watercourse or land treatment area. When consideration is given to maximizing reuse, potential recreational reaches were identified and sewage effluent considered as an aid to maintaining stream flows rather than as a quality deterrent.

During the formulation of the first four plans an effort was made to introduce a wide range of variables to stimulate a broad gage evaluation of potential alternates. This variability applied not only to municipal wastewater, but stormwater as well. For example, Plan 1 proposes all stormwater treatment at local, special stormwater treatment

## PLAN 3

The criteria for Plan 3 were the NDCP Standards, and the treatment method was water-based. In this plan a new concept for stormwater treatment was introduced, that of treating storm runoff during the off-peak hours in a sanitary sewage plant. The concept dictates more numerous, localized sanitary plants where large quantities of stormwater are involved (to maintain stream flows) and more regionalized sanitary plants where little or no stormwater is to be treated (to realize economy of scale for sophisticated, expensive NDCP treatment). Plan 3 has nine additional sanitary sewage plants from Plan 1 to maintain local stream flows and six plants have been eliminated in areas where little or no storm runoff occurs. Sanitary sewage plants were also located with an emphasis on proximity to where stormwater is collected, to facilitate discharge into the existing or proposed sanitary sewer system.

On the east branch of the Rocky River it was felt that one facility near Healy Creek would provide upper basin treatment. On the west branch, Medina County would retain its relatively good plant and expand to meet future needs. The Medina plant would be relocated downstream to serve future development. A facility was needed here to return treated urban runoff to the stream. For similar reasons, the existing Strongsville C plant would be retained and expanded as needed. In the Upper Chagrin River there would be a single facility to serve the Bass Lake-Newbury Township areas rather than two smaller plants. To maintain stream flows above Chagrin Falls, plants similar to Plan 1 are

proposed to maintain stream flow with treated urban runoff. A facility near the confluence with the East Branch would serve the area below Chagrin Falls and keep the wastewater within the basin, as opposed to other plans where effluent flows to Easterly.

In the Upper Cuyahoga several small facilities are combined into larger plants at Burton, Troy Township and a third downstream of Shalersville. In these upper areas there is little or no contaminated stormwater runoff except near the proposed facilities. The new plant at Kent Incorporates a somewhat larger area than Plan I while the Bedford Heights and Macedonia plants, with relatively good existing facilities, are retained to augment stream flow with treated runoff.

Lower basin and shoreline plants are all retained to maximize use of the rather large investment in existing facilities, and because the collection facilities are already constructed which define specific load points.

PLAN 4

Since Plan 2 would achieve NDCP criteria for sanitary sewage by virtue of its land treatment aspects, it was used as a basis for Formulation Plan 4. Urban separate storm runoff receives secondary treatment at sanitary facilities during off-peak hours where stormwater collection points facilitate the practice. In cases where suitable land is available, though, separate storm runoff is pumped directly to storage and then given land treatment.

In either case, the land treatment system for urban storm runoff includes detention storage, winter storage and land application. The

net effect of these facilities upon streams would be to maintain a more constant level of flow by reducing storm runoff peaks, releasing winter runoff during the drier summer months, and recharging groundwater aquifers.

Plant locations for Plan 4 followed a similar rationale as that used for Plan 2. The major new formulation effort for plant location involved urban storm runoff and was done by considering the factors listed in the introductory paragraph.

## PLANS 5 AND 6

Plans 5 and 6 are designed to Ohio State Standards, the former having a water emphasis and the latter a land emphasis. They attempt to optimize plant locations by using criteria developed for Plans 1 and 2. The two plans have essentially the same plants with the main difference being that fourteen plants with tertiary treatment in Plan 5 become secondary plants preceding land treatment in Plan 6. Separate urban storm runoff receives independent treatment at a local collection point when near a plant that discharges to water. When separate storm runoff is near a land treatment plant and suitable land is available, stormwater is detained, then pumped to a storage reservoir for subsequent land treatment.

## PLANS 7 and 8

Using the NDCP Standards, Plan 7 is labeled a water emphasis plan, and Plan 8 labeled a land emphasis plan. As in Plans 3 and 4 there are

basic design concepts that were followed with 7 and 8 attempting to optimize the advantages of plant locations for water and land-based treatment. Following the criteria of smaller, more local plants with nearby land treatment areas, Plan 8 has added five plants, and ten plants with tertiary treatment in Plan 7 have been changed to a land treatment scheme in Plan 8.

Where suitable land treatment sites are nearby, separate storm runoff is either pumped directly from its detention basin to a separate stormwater storage reservoir for subsequent land treatment, or released to a sanitary sewer to receive secondary treatment with the municipal wastewater followed by storage and finally land treatment. (See Schematic Flow Diagram No. 5, p. G-41.) In areas where municipal wastewater receives tertiary water-based treatment, separate storm runoff is routed to the municipal treatment plant from an area for which the design storm runoff can just be accommodated by the plant's off-peak capacity. The remaining drainage areas are served by separate stormwater treatment plants at the collection points. (See Schematic Flow Diagram No. 2, p. G-38).

## PLAN 9

This plan applies NDCP criteria to a massive regionalization scheme of water and land treatment. The Southerly plant is a tertiary facility providing for industrial reuse of effluent. The other four tertiary plants are all directed at maintaining stream flows in their respective basins for critical river reaches. In-basin land treatment is utilized for small size plants in upper basin areas where aerated lagoons would be especially feasible. Two shoreline plants in highly urbanized areas are deleted along with numerous existing or proposed plant locations throughout the Study

Area. The land would revert to the public. All separate urban storm runoff receives treatment in sanitary sewage treatment plants.

PLANS 10 AND 11

See description of Plan 3 for plant selection basis.

PLAN 12

See description of Plans 2 and 4 for the general rationale behind specific plant location. In addition, the Akron area wastewaters are proposed to be treated on land in-basin with this plan. This is to allow evaluation and costing of an Akron in-basin land treatment scheme as opposed to Plans 2 and 4, which take Akron effluent flows to western Ohio.

As shown in Figure II-2 on page 14-B of Appendix V, Part 2, during dry months the discharge from the Akron Sewage Treatment Plant constitutes more than half of the flow at that point in the Cuyahoga River. Thus, an important feature of Plan 12 is the provision of land treatment sites for Akron located so that the return flow could be routed into the Cuyhoga at or above the present site of the Akron Sewage Treatment Plant.

## SANITARY SEWAGE FLOWS

Sanitary sewage flows for the year 2020 have been calculated by Havens and Emerson based on their development projections. While development projections are never accurate, these are believed to be reasonable for preliminary plan design and comparison purposes. Projected flows for the service area of each treatment plant are given in Table A for each plan at the end of this Appendix. The total quantities of sanitary sewage to be treated are the same for all plans.

Some areas in the Three-River Basin (primarily the older developed areas of Cleveland and Akron) are now served by combined sewers, which collect both sanitary sewage and storm water runoff. Havens and Emerson studies have indicated that separation of these sewers would be economically infeasible. In all cases, combined sewage is treated as if it were sanitary only. It is assumed that regulations will prevent further construction of combined storm runoff - sanitary sewage collection systems.

Sanitary sewage flows vary daily and seasonally; therefore, definition of design flows actually requires the definition of a design flow curve. For the existing larger metropolitan plants, flow curves are based on actual experience. For other plants, the flow ratios are assumed as given in Table G-2.

For this study, nominal plant capacity is defined as the average daily flow based on a one-year period.

Cleveland-Akron-Three Rivers area, it was desirable to recognize certain principals relative to storm runoff. These are as follows:

1. Rural storm runoff is relatively clean compared with urban storm runoff, although it may contain significant pollutant loads in some cases. Future attention may be required to solve this problem. These 12 alternative plans, however, involve only urban storm drainage.

2. The preventive approach, as used in industry (waste reduction), and according to the Soil Conservation Service ethic, must be applied to storm runoff. Otherwise, treatment of the grossly contaminated high-volume flows could likely prove economically infeasible. Examples of preventive measures are:

   a. Upstream detention ponding to reduce flow rate and, hence, erosive nature.

   b. Control of land use, requiring planting and elimination of barren or easily erodible surfaces and special care in construction areas.

   c. Control of fertilizer applications and techniques.

   d. A high degree of street and other area surface cleaning, including control of cleanliness in private areas.

3. In many cases under State *criteria*, separately collected urban runoff -- because of large volumes and the low pollutant levels -- was most advantageously treated and disposed of separately from domestic wastes.

Under NDCP criteria it was necessary to apply either physical-chemical or land treatment processes to the separately treated storm runoff*. These methods would logically require the incorporation of the many storage sedimentation basins described for State standards planning.

The outlying area in the Three Rivers watershed is generally green and lush. Storm runoff from these areas is now minimal and of good quality. Much of the already developed area is low-density suburban housing -- the general density range being one dwelling unit per acre or less. These low-density residential areas provide a

* Advanced biological treatment processes are not compatible with periodic operation and highly variable constituent loadings, which would characterize separate storm runoff treatment.

very high percentage of green area, typically having large lawns and trees, with narrow paved streets and without curbs or gutters.

It would be impractical and unnecessary to consider the collection and treatment of storm runoff from these undeveloped or low-density suburban residential areas. It was, therefore, assumed that, for areas having a projected impervious ratio of less than 10 percent, water quality could be adequately protected using institutional measures and that storm runoff would not be collected and treated.

For the more densely developed areas, the contaminated flows would be collected and treated. For basins which will have impervious areas between 10 and 40 percent, the polluted portions of the storm runoff from urbanized areas will be collected and treated, and other portions will be allowed to run off naturally. Estimates of urban storm runoff from 162 sub-basins were made by Havens and Emerson. Transmission facilities have been sized to accommodate the one-year storm into detention storage, larger runoffs being beyond the design criteria.

In some cases under NDCP criteria, urban storm runoff will be detained as described elsewhere, and released during "off-peak" hours to sanitary sewage facilities for treatment. The "off-peak" capacity consists of utilizing fluctuations in the diurnal sanitary flow hydrograph. Treatment plants are sized to handle the peak load that occurs during a day (MF) both in terms of hydraulic and unit process design.

Stormwater pollutant characteristics are highly variable, ranging from the more dilute separated urban runoff to the concentrated combined system runoff. Typical separate system characteristics show a suspended solids level of 500 mg/l and a five-day BOD level of 30 mg/l. Combined

system overflows may evidence the "first flush" concentration where stormwater re-suspends settled organic and inorganic constituents deposited in the large combined sewers, so that the suspended solids and BOD levels may actually be higher than for domestic sewage. As the storm progresses, the combined sewage concentration typically approaches a suspended solids level of 200 mg/l and a BOD of 60 mg/l. Plain settling in the detention, or storage, basins will reduce suspended solids by as much as 70 percent with a corresponding BOD reduction of about 40 percent. For separated urban runoff the effluent from the detention basin will have a suspended solids concentration similar to sanitary sewage with a low BOD.

Separately collected storm runoff may be treated in municipal activated-sludge plants when off-peak capacity is available. This would have some effect upon the biological-mass dependent processes. Sludge recycling would probably be increased with little or no wasting of sludge, both for the carbonaceous and nitrogenous-demanding portion of the plant. In practice the separate storm water might be released to the high-rate activated sludge clarifier, or as influent to the nitrifying portion of a biological plant due to the similarity of its oxygen demand to secondary effluent. For this alternative release point, the graded media filters would have a higher suspended solids loading and require more frequent backwashing. For combined systems runoff, solids would be kept in suspension by mixing and aeration and then released to the sanitary plants so that a minimum of offensive sludge buildup would occur at the storage facility and most of the sludge removal would take place at the sanitary plant. In addition, the characteristics of combined sewage would be maintained

so as to minimize the effect on the sanitary plant unit processes. Combined system runoff treated under this alternative becomes nothing more than a "flow-leveling" technique so that sanitary plant capacity is more fully utilized.

Since the capacity of a sanitary facility is adequate for Maximum Flow during most of the day, the sanitary flow is less than the design hydraulic capacity. The difference between maximum flow (MF) and maximum daily flow (MDF) is defined as the "off-peak" capacity of a treatment facility. It is proposed that some storm water would be detained in mined, concrete, or earthen storage basins, then released to sanitary interceptors for treatment during the off-peak hours at designated sanitary sewage plants. Some of the advantages of this type of storm water treatment, as opposed to construction of a separate storm water facility, include:

1. More effective utilization of existing sewage treatment plants and sewer systems, especially during low-flow nighttime hours;
2. Minimal or no operation and maintenance problems at the storm water storage basins, which would probably be controlled at the plant or by an automatic controller which would discharge when sensing low sewer flows;
3. Since there is essentially no method of separating storm sewer flows from domestic sewage in "combined" areas, this method merely proposes treating all the "combined" overflows in plants with unit processes to handle combined sewage characteristics;

industrial waste treatment plants, which are preliminarily designed and cost-estimated by AWARE. Where possible, industries will directly reuse treated wastewater. Where practical, industrial waste sludges would be disposed of jointly with municipal sludges.

Different levels of industrial pretreatment will be required depending on whether a water or land-based plant follows the industrial pretreatment.** If the industry precedes a biological type facility discharging to a waterway, then high level pretreatment removals would be required so that following the biological treatment, remaining contaminant concentrations would meet the required standards. For an industry preceding a biological treatment facility discharging to storage for subsequent land treatment, pretreatment removals would be less stringent. For aerated lagoon secondary treatment, the pretreatment needed at the industry would be least.* A condition upon pretreatment under either type of final discharge or treatment is that industrial wastes would first be rendered compatible for the biological treatment, as described previously.

Cooling waters, as defined here, are only heat-contaminated. Because of the high flow rates and lack of chemical pollutants, it is economically impractical to transmit and treat cooling water using the municipal sewerage system. Of the total projected 2020 industrial water requirement of 766 MGD, a significant portion is for cooling water. Stream and effluent standards will require cooling water treatment for temperature reduction, so that direct recycling of cooling water requirements will become common practice. Design assumptions that can be made

* Long detention periods and large volumes in the lagoons provide capability for inadvertent shock loads.

** The final phase of this study assumed a single level of industrial pretreatment for the 3 final alternative plans. See Part 2 of this Appendix, page IV-3.

relative to cooling water demands and disposal are summarized below:

1. Treatment and disposal of the main flow will be independent of the sanitary/storm sewerage systems.

2. Treatment (cooling) will be required before discharge into lakes and streams.

3. Recycling cooling flows will be practical, and probably mandatory, due to effluent temperature standards. Total cooling water demands need not be imposed on the source.

4. Although not theoretically provided for in the published design criteria, Lake Erie might be an acceptable recipient for some heated water, providing adequate dispersion/diffusion systems were utilized.

5. Blowdown water from cooling towers would be discharged to the municipal sewerage system.

6. A potential for combination benefits may exist where cooling towers (or mechanical aerators) can also be used for dissolved oxygen supplementation.

7. Sewage effluent/cooling uses should be combined when practical.

Cost of Industrial Wastewater Treatment. The magnitude of the industrial wastewater problem in the Study Area is illustrated by the fact that approximately 65 percent of the wastewater influent to Lake Erie in Northeastern Ohio in 1970 originated from industry. The problem was considered of such importance that it comprised one entire Contract of the total Three Rivers Watershed Wastewater Management Study. Associated Water and Air Resources Engineers, Inc. (AWARE) of Nashville, Tennessee, was engaged to identify the problems and develop alternative solutions.

In AWARE's Phase I report the total industrial wastewater loads originating in the Study Area for the present time and for the future from 1990 to 2020 were identified. These loads were used as a basis for the

(AWARE Phase I Report Attachment E). The flows were totaled for both systems and a percent of the total flow for each system was identified. This percentage figure, based on flow, was then applied to the total treatment cost figure for the SIC category within the proper industrial pretreatment alternative. (AWARE Phase 2 Report, Tables 26 - 30). The sludge disposal and brine treatment costs were prorated to each land or water-based system, based on a percentage figure, by flow. (AWARE Phase 2 Report, Tables 32 - 37). Using this technique, it was possible to arrive at a reasonable estimate of the Total Project Cost of Industrial treatment of wastes for each of the twelve alternative Plans. To convert the figure to an Annual Cost basis, the Total Project Cost was amortized over a 50-year life. Amortizing to obtain Annual Cost in this manner does not take into account the varying life expectancy of the treatment components, but it does provide a figure that can be used on a comparative cost basis, just as a Present Worth figure can be used to indicate the comparative capital cost of a particular plan based on 1972 dollars.

One of the assumptions made was to use a seven percent interest rate* similar to cost calculations made for municipal and stormwater flows. Another assumption necessary to arrive at a single annual cost figure was that brine treatment would be by evaporation. This assumption coincides with that proposed by the municipal wastewater contractor, which identified evaporation as the most feasible disposal alternative for brines in the Three Rivers Watershed area.

It should be noted that the annual costs calculated in this Section include both treatment facilities required for waste to be discharged

* The interest rates selected were 5-3/8, 7 and 10 percent, in accordance with OCE guidance. The 7 percent rate was used for the cost comparisons in the first phase of the study.

directly to waterways (primarily SIC 33, Steel Production) and facilities required for pretreatment of waste constituents prior to discharge to municipal sewer systems, but do not include any charges to industry for the treatment of industrial waste in municipal treatment systems. These latter costs allocable to industry will be examined in the Phase 3 report by AWARE.

Table 7 in the Summary Section of this Appendix presents the specific industrial wastewater treatment costs for each plan reduced to an annual cost figure as described above. The annual costs for stormwater and municipal wastewater treatment for each plan are then brought forward from Table 4, and the total annual cost for each plan, including treatment of all three categories of wastewater, is given in the last column of Table 7.

## SCHEMATIC FLOW DIAGRAMS

Detailed descriptions of alternative treatment processes are found in the respective Phase Reports by Havens and Emerson concerning municipal wastewater and urban storm runoff treatment; by AWARE with regard to industrial pretreatment; and by Wright-McLaughlin Engineers for land treatment. For formulation purposes, though, general schematic diagrams are shown on the following six pages to illustrate design concepts for typical situations.

be treated. The high temperatures needed to oxidize odor-producing organics and PCB's produce another pollutant, oxides of nitrogen. To date, no efficient and economical methods of removing oxides of nitrogen have been developed.

Incineration does not completely replace landfill operations, but substantially reduces the need for them. Up to 35 per cent of the solid matter found in the sludge ends up as ash, and must be disposed of, usually in a landfill. The actual solids quantity is considerably less since all water is removed.

From a resource standpoint, incineration is a negative process. Because of the inefficiency of burning a product containing so much water, additional energy sources are needed to destroy what is actually an energy source in itself. The solid material, which in the form of sludge could be considered a resource of some value, is converted to a form which has little use, and must be disposed of without benefit to agriculture.

Since incinerators require constant attention in order to work efficiently, they are practical only on a large scale. This alternative should be costed, but its economic advantages, if any, must be weighed against the severe resource and evnironmental drawbacks before it can be compared realistically with alternate methods of sludge disposal.

## Agricultural Application

Sewage sludge has been applied to cropland for centuries, and with

generally beneficial effect. The organic matter and plant nutrients in the sludge not only provide needed materials for the crops currently grown, but also, together with the mineral fraction, help to rebuild soils which would otherwise be depleted through cropping and erosion. There is an optimum rate of application of sludge to land, however. If this optimum value is exceeded, certain elements may build up in the soil which may prove to be detrimental to the plant life growing there. This is particularly true if the sludge contains substantial amounts of heavy metals, which is likely to occur in heavily industrialized areas.

Thus, the application of sludge to cropland is likely to be the best method of disposal under amenable physical conditions and where the application can be well managed. Monitoring of soil, crop, and groundwater conditions and the rotation of crops would play roles in the management program to ensure optimum results. Sludge application might be repeated at periods of from ten to twenty years as experience indicates the best interval for crop response.* This flexibility in managing the application of sludge is feasible due to the relatively small amount of land required for the annual volume of sludge produced. This method of sludge disposal on agricultural lands has been incorporated into Plan Nos. 9 and 12.

Strip Mine Application

Over 200,000 acres of land in southeastern Ohio have been strip mined. This operation leaves the land in a desolate condition. Vegetation and topsoil are removed and the new surface is a broken sterile mass of acid, mineral rock and clay. Subsequent erosion is severe and water pollution, both by suspended solids and acid solution, has made

* Annual applications of up to 10 to 25 tons/acre/year are also feasible with good management as demonstrated at University of Illinois.

most streams totally unproductive. New laws will require that the land be restored to some semblance of its original condition, but this can be done only with considerable effort. What is needed is the application of heavy doses of matter of high pH (to neutralize the acid conditions), high organic content, and high content of plant nutrients. Sewage sludge fulfills these requirements.*

An abandoned pipeline, formerly used for coal slurry, connects the Cleveland area with the heart of the strip mine lands, making about 75,000 acres of mined land accessible. While the pipeline may or may not be usable in its present contition, the right-of-way associated with it could prove valuable, since a new pipeline could be installed with little legal difficulty. Sludge could be transported from the end of the pipeline (or intervening stations) by the construction of distribution lines or by truck.

New methods of injecting sludge into the soil could make it feasible to treat the land in depth, making it capable of a sustained yield of heavy plant growth (surface application alone could lead to a limit in plant growth after a few years, as the roots reach down to a depth which remains acid). Depths of application could range up to a total of two to three feet of sludge or more; such a rate would provide a virtually unlimited depository for the sludge, especially if strip mining continues. Injection would help conserve nitrogen for plant use.

Digested sludge having a moisture content in the range of two to five percent solids would be used for this purpose.

* The pH of sewage sludge generally falls into the range of 6.5 to 7.5, though it would be higher if lime were used for phosphorus removal.

Disadvantages of land disposal of sludge which were discussed earlier (carbonic acid from organic decay and heavy metals) would become lost in the overwhelming acidity and metal content of the strip mine spoil, leading to ecological results which would be mainly beneficial. While the restored lands could not be used for agricultural purposes without extensive leveling and removal of rocks, it would be ideal for woodlands without the need for expensive reworking. The best ultimate purpose of such lands may be for wildlife and recreational purposes. This could be enhanced even more by improvement of the numerous ponds created by the mining operations as acid flow conditions are reversed by sludge application.

This alternative method of sludge disposal rates very high in terms of social, environmental, and resource utilization factors.

Sludge Disposal Selection

The method of sludge disposal chosen for each plant in Formulation Plans 1 through 12 reflects the considerations discussed in this section in conjunction with the type of sludge produced. However, general rules followed as the plans developed.

Plans 1 and 11 used incineration throughout to dispose of sludge. Incineration was primarily proposed to reclaim chemicals and thus reduce the burden of high O & M costs. Ash, resulting as a by-product of reclamation is sterile and inert., allowing for landfill disposal.

Those plans utilizing all land-based disposal (2, 4, and 12) have conventional activated sludge plants or aerated lagoons. As the sludge

generated by these plants is rich in nutrients and valuable as a fertilizer, it is only used for agricultural or strip mine application.

The remaining plans are combinations of land and water-based plants and, as such, contain preliminary secondary, advanced biological and/or physical-chemical treatment plants in various arrangements. Where possible, agricultural application of sludge is favored, especially in the upper portions of the Rocky River and Cuyahoga River Basins. Those plants located within reasonable distances of the existing pipeline to the strip mine areas usually have their sludge pumped out of the basins to rehabilitate these sites. This is generally true also for the large shoreline plants which lack sufficient land area for agriculatural application.

## SYSTEMS RELIABILITY

Many present pollution problems occur as a result of the lack of reliability features. Plants, pipelines, and pumping stations which operate satisfactorily even 360 days per year, with substantial failure during the remainder, are unacceptable. Wastewater management criteria can no longer be based on average conditions. It is assumed that all facilities design will conform, initially, to the Ten-States standards or better, and be reviewed by the appropriate local, state and federal control agencies. Treatment plant reliability design, under State Standards criteria, must produce effluent qualities with maximum variations as prescribed in the Ohio/EPA standards. NDCP reliability criteria requires virtually 100 percent reliability, using storage as needed.

As a rule, the pumping and pressure transmission of raw sanitary sewage in collection systems will only be used when no reasonable alternative exists. This premise generally will result in traditional collection trunk sewer system design, wherein natural drainageways and drainage basins govern layout. It generally will preclude the inter-basin transfer of untreated wastewaters, except where special provisions are made for transportation of effluent for land treatment purposes.

For purposes of comparison, all plans have been formulated, designed, and costed, based on comparable reliability design for either Ohio/EPA or NDCP levels*.

## REUSE OF EFFLUENT

The reuse of effluent, including the reclaiming and recycling of water, can take many forms, to varying degrees, to create additional urban and rural benefits. The reuse of sewage effluent can range from

* See also Part 2 of this Appendix, page VI-4.

low flow augmentation of area streams for recreational environmental and water supply purposes to the providing of large cooling water lake surfaces for new power plant sitings. The type and extent of the reuse would be limited only by need, economics, and imaginative planning.

Reuse of treated sewage effluent is an integral aspect of urban water management, where the water system is a part of the total urban system, and the wastewater system is in turn a subsystem of the former. Thus, it is incumbent upon wastewater management planners to give full consideration to the reuse of sewage effluent to the maximum practical extent.

Some categories of reuse are essentially applicable only to those plans with water-based discharge characteristics, while others can practically be related only to land treatment plans or land treatment components. In the following discussion of reuse aspects, the general applicability of each of the opportunities is discussed.

Low Flow Augmentation

The augmentation of low flow in streams for esthetic, recreational, and water supply purposes falls into two categories, the first for the Three Rivers Basin where benefits acrue locally, and secondly in the outlying basins west of Cleveland. The in-basin augmentation applies to both water-based and in-basin land-based treatment,while the western Ohio low flow augmentation is related to the land treatment method in those counties. The value of storage for regulation of streamflow including effects on navigation, recreation, esthetics, and fish and wildlife

should be accounted for in determining total benefits of multiple-purpose planning.

The return flow from the western Ohio land treatment management areas would often be in the 1000 to 1500 cfs range for the irrigation period. This return flow could be distributed over numerous streams including:

| | |
|---|---|
| Black River | Muddy Creek |
| Vermilion River | Sugar Creek |
| Huron River | Portage River |
| Sandusky River | Blanchard River |
| Muskellunge Creek | Maumee River |

Upland reservoirs as described in State of Ohio studies would be provided where needed to equate supply to low flow periods in the streams. Numerous recreational opportunities exist to be developed in conjuntion with this reuse, including fishing, boating, swimming, and hunting. Wildlife refuge and bird habitats would also be included. Water supply potential for communities and industry will be enhanced.

In the Three Rivers watershed, the return flow from land treatment areas will beneficially raise the low flows of the upper Cuyahoga and the Upper Rocky River.

The return flow from tertiary wastewater plants also acts beneficially for flow augmentation. This is especially important upon recognizing that in the future much of the water supply for the Three Rivers watershed will come from Cleveland sources (Lake Erie). The treated wastewater then acts as a supplement to the natural stream flow. In addition, when the water is discharged to a relatively insignificant stream flow, the purified wastewater actually tends to "equalize" stream

effluent would be routed to the industrial use prior to discharge to the Effluent Transmission Tunnel. The water-based plans all incorporate the Southerly Plant into the overall scheme which provides for opportunity for the industries to use tertiary effluent.

The industrial reuse could be for both process water and cooling water.

Power Plant Cooling

The existing power plants in the Cleveland area generally utilize Lake Erie water or Cuyahoga River water for flow-through cooling. The trend on newer installations is to cooling towers. The constant and dependable supply of treated sewage effluent makes possible flow-through cooling use in power plants in some cases, though the available sewage effluent flow rate is often limited when compared with the total needs for the larger power plants. Nevertheless, opportunities exist which can be utilized for both land and water-based plans. Makeup water for the power plants can be provided using more highly treated effluent.

Recreational Water Use

The augmentation of low stream flow is oriented towards recreational use and aesthetics in and on the water. Where canoeing, kayaking, and rafting is of special significance, the final layout of return flow points and release of water from reservoirs can be timed to accommodate these specific and important water needs. These opportunities apply to both land and water-based plans. The effects of the wastewater management plans on stream flow quantities are discussed under "Stream

Flow Impact."

The construction of storage reservoirs for storm runoff detention provides basins throughout the Three Rivers Basin with some environmental benefits which would be tailored to the specific site and area needs. Stormwater detention basins in some cities provide significant additions to parks and open spaces.

## Sand and Silt Reuse

The basins for stormwater detention/retention also provide settling basins for partial treatment. The sand and silt deposits provide a resource of material suitable for fill material and top soil. Demonstration projects have shown such material can be sold to public works agencies and private parties at reasonable costs ranging upwards from $0.25 per cubic yard. In some basins the quality of the bottom deposits may preclude general use, and in these instances the material may be suitable only for disposal to land fill areas in new developments, or perhaps as solid waste. The water-based plans, as well as land-based plans, lend themselves to this reuse of the settled material. However, land-based plans would lend themselves more to using sand and silt on land as a conditioner and for nutrients because of land management control associated with land teatment systems.

## Nutrient Reuse

In addition to the water portion, which can be reused, sewage contains solids available for reuse. A plan involving maximum reuse must consider the fate of nutrients and other organic solids.

## NON-STRUCTURAL ALTERNATIVES

In conjunction with the physical works proposed in the formulation plans for wastewater management, non-structural measures will be necessary. These include, but are not limited to, the following:

1. Roof-top ponding ordinance for Cleveland and Akron for storm runoff.
2. Flood plain regulation basin-wide.
3. Upstream ponding regulations for new developments and urban renewal, including the "blue-green" technique of the Department of Housing and Urban Development. *
4. Cooling water recycling for power plants and industry.
5. Street cleaning ordinances and resolutions to remove solids by sweeping rather than via the sewer system.
6. Land surface protection and cleanliness regulations, including construction site erosion control practices.
7. Reduction of use of de-icing chemicals.
8. Development of area-wide regulations on solid waste disposal management.
9. Land-use regulations to limit and control unplanned urban sprawl.
10. Agricultural regulations related to winter fertilizer applications on frozen ground, as well as educational work by the Soil Conservation Service relative to artificial fertilizer applications.
11. Regulations on potential pollutant levels in consumer goods, for example phosphate regulations on commercial detergents.
12. The development of water savings devices for the home, including reuse systems.

* A technique of urban water resources management to detain water and create urban open space.

## STORAGE

### Peak Flow Storage

Throughout the Plans, water storage basins are used to detain peak flows. Such storage results in system economies and reliability. Long conduits (pipeline or tunnels) can have substantially lower design capacities when preceded by an upstream detention basin. Treatment plant peak capacities can similarly be made much less using flow leveling techniques.

Open reservoirs, suitably landscaped and fenced, are considered satisfactory for detention of separate storm runoff. In some cases, because of land shortages, storm runoff is planned to be contained in closed basins or underground.

Underground or covered reservoirs are an assumed requirement for storing combined storm runoff or domestic-industrial wastewater.*

The quantity of storm runoff to be detained varies, depending on the type of treatment it is to receive. In general for storm runoff receiving separate treatment, the one-year storm volume would be detained, and released over a selected period of time. This detention period would also include stormwater being pumped directly to winter storage sites for subsequent land treatment. For combined storm runoff that is stored and then treated during the off-peak hours at existing sanitary plants, storage is again provided for the one-year storm, to include solids suspension, and released in three days or less. For separate storm runoff treated during the off-peak capacity, runoff volumes are such that storage

* As defined by Havens and Emerson, Ltd.

for more than the one-year storm usually needs to be provided. The storage would be sized so that the stormwater flow to treatment would be equal or less than the off-peak capacity, previously defined as the maximum flow accepted for treatment (MF) minus the maximum daily flow (MDF). Although the more typical off-peak capacity would be (MF) minus (ADF), average daily flow, it is believed that the off-peak capacity defined (MF-MDF) represents a somewhat conservative basis and is adequate for general planning purposes. On refining the design assumptions, a more critical evaluation could be made as to the effect of stormwater on conventional unit processes either on a pilot plant basis or under full-scale conditions. Systems under construction or on-line in Boston, Milwaukee, Dallas, and Columbus will also help evaluate the off-peak capacity. Hydraulically, the conventional sanitary plants would be capable of another 0.5 ADF on most days, and it may be that refinement would include this additional amount as available stormwater capacity. For formulation purposes, detention storage equal to 80 percent of the maximum 30-day runoff was assumed when separate storm runoff was released to sanitary plants. In the Three Rivers Basin, the maximum 30-day runoff amounts to approximately 20 percent of the annual runoff.*

The various types of storage reservoirs used in the Plans are described below.

Concrete and Earthen Basins

In outlying areas of the Three Rivers Basin and especially where stormwater is collected via small streams and natural drainageways,

* In the formulation of the final alternatives further refinements were made.

storage will generally be in earthen basins, suitably prepared, and utilized for multiple benefits where applicable. Earthen basins for low-contaminant runoff could easily be incorporated into planning for parks and recreational areas.

Concrete basins, with or without mechanical sludge removal facilities, would be used in more densely populated areas where land is at a premium and higher contaminant loads preclude using the runoff for environmental enhancement functions. Basins could be logically incorporated into underground or overhead parking structures for subsequent pumping out. Sludge disposal could be on-site or collected and disposed of with sanitary sewage plant solids.

Underground Mined Storage

The use of underground mined storage at selected locations in the dense urban areas will provide for detention of peak runoffs of combined sewer overflows. Such storage can also be used in conjunction with the reduction of separated urban storm runoff for selected cases.

Underground storage related to the Effluent Transmission Tunnel, as well as surcharge storage which would float on the hydraulic grade line of the tunnel at the Cleveland Westerly load point, would provide for the acceptance by the tunnel of large peak discharges without much oversizing of the tunnel.

Underground mined storage would be created using common mining techniques of room and pillar ecavation similar to methods used in the mining industry. Such construction, already widely practiced, can drop excavation

costs to perhaps one-fifth of what might normally be estimated. Underground mined storage chambers would be lined with concrete to prevent deterioration of the shale surface. It would be possible to continue the excavation of mined storage in a phased sequence over a long period of years, keeping pace with the increasing domestic sewage loads and increased urban storm runoff.

Offshore Basin Storage

The development of offshore stabilization-retention basins could be provided in Lake Erie. The basin, or basins, could also be coordinated with dredging disposal operations to provide for more economical construction as well as treatment and storage of the dredging liquid pollutants.

An additional synergistic use would be the creation of additional land for tertiary treatment plant sites at the present locations to avoid the necessity of acquiring already developed adjacent property.

The offshore basin concept has been specifically identified in one combination plan primarily oriented to a water-based approach; however, the offshore basins could be utilized in land treatment schemes as well for the holding of storm runoff for release to the secondary treatment plant or a primary plant, prior to controlled release to the Effluent Transmission Tunnel.

LAND TREATMENT

The land treatment technology and degree of wastewater renovation are discussed in detail in Appendix V, Part I, Section IX and X; Part 2, Section III and V; and Part 3, Section III. However, it should be noted that soils selected for land treatment in this study

include the following associations with application rates as indicated.

| Soil Association | Location | Effluent | Application Rate |
|---|---|---|---|
| Chili | In Basin | Municipal/Industrial | 60 in/yr |
| Cardington-Bennington | Western Area | Municipal/Industrial & Storm Runoff | 50, 75, & 90 in/yr |
| Mahoning-Ellsworth | In Basin | Municipal/Industrial & Storm Runoff | 90 in/yr<br>150 in/yr |

Areas of land involved in land treatment for each of the plans are presented in the next section of this appendix in Table 3, entitled "Summary of Major Components of Twelve Alternate Plans."

Farm Management

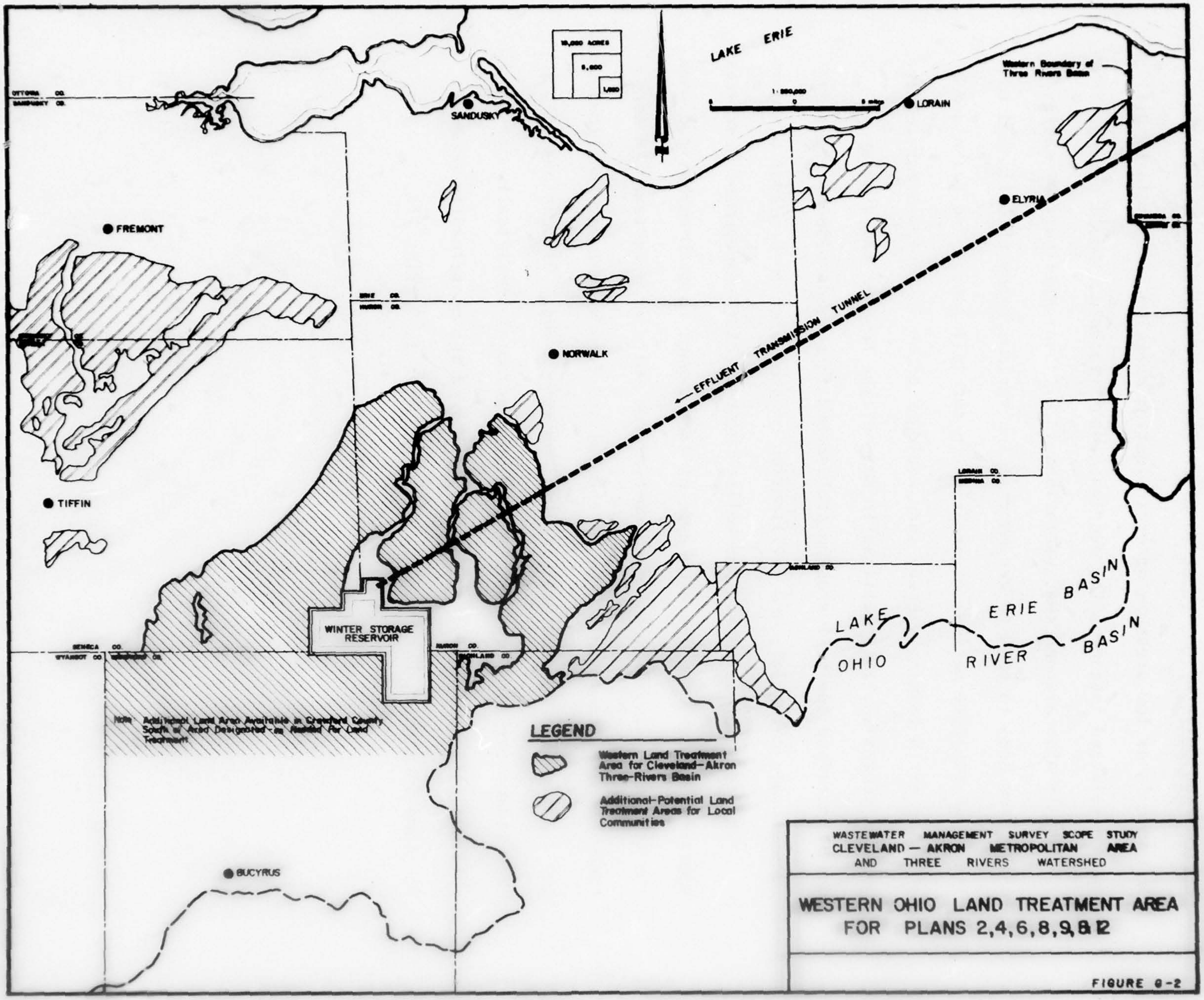
The success of land treatment with sewage effluent on agricultural lands, whereby the nutrients are recycled back to the soil to satisfy crop needs, and the water is utilized as a vehicle for transporting the nutrients as well as to satisfy periodic evapo-transpiration shortages, is closely related to farm management. It is anticipated that in the Lake Erie basin of northern Ohio optimum farm management practices would require significant educational efforts because of the irrigation equipment, the extensive artificial drainage network, and the need for maintaining specific subsoil conditions to optimize the removation capacity of the soil, as well as to maximize crop production.

Different types of farm management will be required from one area to another. For instance, on some soils fixed irrigation equipment would be chosen to better control droplet size and impact velocity, while on other lands rotating boom sprinklers would be utilized having

bottom feed polyethylene tubes to place the water directly into furrows. On some lands low pressure spray irrigation rotating rigs would be utilized, and in selected instances the overland runoff technique would be specified.

It is also planned that variations in effluent applications would exist from area to area to accommodate the various types of soils and to insure appropriate periods of aeration in the soil zone. The technique of using strip farming whereby corn would be grown in strips separated by grassed strips would be utilized in some of the heavier and tighter soils to reduce the soil erosion problem and to provide significant surface storage potential, and infiltration of the water in a matter of hours.

The need for selective and well-thought-out farm management practices specifically designed for each type of land cannot be over-emphasized when the irrigation and drainage of fine-textured soils is undertaken in northern Ohio. Without this type of specialized farm management practice, one could anticipate agricultural failures in some areas. Discussions of the farm management techniques which have been proposed specifically for the soil and climatic conditions in the study area are contained in Appendix V - Land Treatment, Part 1, Section IX and Part 3, Section III.




WASTEWATER MANAGEMENT SURVEY SCOPE STUDY
CLEVELAND — AKRON METROPOLITAN AREA
AND THREE RIVERS WATERSHED

**WESTERN OHIO LAND TREATMENT AREA**
**FOR PLANS 2,4,6,8,9,& 12**

FIGURE G-2

## BASIS FOR COMPARATIVE COST ESTIMATES

An essential task of the Survey Scope Study was to provide the basis for a cost comparison of the twelve alternative plans developed during the earlier stages of the study.

The cost estimates were to be prepared and presented in such a way as to permit not only comparisons among the plans, but also identification of the costs of the various major components of each plan, e. g., sewers, treatment plants, pumps, and reservoirs, and a separation of the costs related to treating stormwater from the costs of treating municipal and industrial wastewaters in each plan. The cost figures to be used for these three purposes were to incorporate both construction costs (Capital Costs) and the costs of operating and maintaining the systems after construction (O & M costs), using cost curve relationships where practical.

### Initial Costing for Comparability

The need for an initial cost comparability among plans led to the adoption of a standardized procedure for design work and cost estimation for this early work. First, each plan was laid out to meet projected wastewater loads for the year 2020. Second, the costing procedure assumed that the 2020 facilities would be built at one time using current (1972) costs. Third, the total capital cost for each component of the wastewater treatment system was converted to an annual payment amount based on a seven percent interest rate* amortized over the estimated useful life of the particular component. The replacement cost for each component was incorporated in this annual capital cost payment by use of a

* The interest rates used in this study were 5-3/8, 7 and 10 percent, in accordance with OCE guidance. The 7 percent rate was used for the cost comparisons during the first phase of the study.

capital recovery factor related to the component's estimated useful life. Finally, the annual capital cost for each component of the plan was added to the annual operation and maintenance (O & M) cost and this total represents the "annual comparable cost" for that particular component of the plan.

In order to facilitate comparisons among plans, a single "annual comparable cost" for each plan was needed. This was accomplished by totaling the capital and O & M costs of the individual plan components and then adding a uniform contingency factor of 30 percent* (including five percent for engineering and design and five percent for supervision and administration) to the total annual capital cost, and a 20 percent* contigency factor to the total annual O & M cost for each plan. The sum of these two figures was the plan's annual comparable cost.

The development of annual comparable costs described above assumes that the wastewater treatment systems in each plan can be broken down into separate components or cost items, for which capital and O & M costs can be calculated. Since the same general components are used in all plans, but in varying combinations and sizes, it was possible to set up a standardized table for detailed cost computations, in which each column represented a separate cost item. In these tables, collection and conventional in-plant treatment facilities were designed and cost estimated by Havens and Emerson, Ltd., of Cleveland. However, where aerated lagoons were utilized in land treatment, the cost figures for the aerated lagoon component were shown separately. Those components related only to systems incorporating land treatment were designed and costed by

* The contingency factors were established in the Wastewater Management Program Study Procedure, dated 1 May 1972, to ensure consistency among the several concurrent Survey Scope Studies.

their land cost estimate: "The estimate listed herein is not based upon appraisals; therefore, the prices are estimates only. In addition, the cost for farm buildings to be acquired can vary greatly, depending upon the areas selected, and until a firm plan is available, no definite amounts can be given."

## Sources of Costing Information

In addition to the accumulated costing experience of Wright-McLaughlin, Havens and Emerson, and AWARE, a number of other organizations were consulted to obtain as broad a base as possible for costing the twelve alternative wastewater management plans. Cost data from actual contract bids is the preferred source of costing information, and such actual unit costs were used as a basis wherever practical. Governmental Agencies, such as the United States Bureau of Reclamation, played an important role in providing information. The Corps of Engineers supplied special research material prepared under contract, such as the "CRREL Report", and compiled resource material and cost curves for consultants engaged in pilot studies currently under way. The Environmental Protection Agency, and other agencies directly concerned with wastewater management, prepared background studies and prototype environmental impact statements. Other sources of information included the consulting firms of Bauer Engineering, Inc. and Woodward-Clevenger Associates, Inc., university personnel, manufacturers, and articles and reprints from various journals.

## Sharing of Costs

As defined on page 160 of the Summary Report, Study Area taxpayers would pay 25% of Capital Costs and 100% of O & M Costs; Federal taxpayers would pay 75% of Capital Costs, and Industry would pay 100% of industrial pretreatment costs.

TABLE 1

AREAL DISTRIBUTION OF POTABLE WATER SUPPLIES AND WASTEWATER END PRODUCTS
FOR CLEVELAND-AKRON THREE-RIVERS BASIN STUDY AREA

PLAN NUMBER 1

| SOURCES AND DISTRIBUTION OF POTABLE WATER SUPPLY PRODUCTION (BASED ON 1970 STATE DEPARTMENT OF HEALTH WATER SUPPLY INVENTORY) | | | | POINT OF GENERATION VS POINT OF DISPOSAL OF LIQUID AND SOLID WASTEWATER TREATMENT FINAL PRODUCTS | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PERCENTAGE FROM VARIOUS SOURCES | | | WATER SUPPLY DISTRIBUTION (1970 CONDITIONS) | WASTEWATER GENERATION (2020 PROJECTIONS) | | PERCENTAGE OF EACH FINAL PRODUCT GOING TO VARIOUS DISPOSAL POINTS | | | | | | | | |
| | | | | | | LIQUID (EFFLUENT) | | | | | SOLID (SLUDGE) | | | |
| | | | | | | | | | LAND TREATMENT | | | | | |
| DIRECT FROM LAKE ERIE | RESERVOIRS AND STREAMS | SPRINGS AND WELLS | PERCENT OF TOTAL SUPPLY | BASIN | * PERCENT OF TOTAL GENERATED | STREAMS IN BASIN OF ORIGIN | STREAMS OUTSIDE BASIN OF ORIGIN | DIRECT TO LAKE ERIE | IN BASIN OF ORIGIN | OUTSIDE BASIN OF ORIGIN | INCINERATION (ASH TO LANDFILL) | STRIP MINED AREAS | LAND IN BASIN OF ORIGIN | LAND OUTSIDE BASIN OF ORIGIN |
| | | | | ROCKY RIVER | | | | | | | | | | |
| --- | 0.2 | 0.1 | 0.3 | Upper Area | 2.9 (22.92) | 2.9 | | | | | 2.9 | | | |
| --- | 0.4 | 0.1 | 0.5 | Middle Are | 4.7 (36.99) | 4.7 | | | | | 4.7 | | | |
| 7.8 | --- | --- | 7.8 | Lower Area | 2.6 (21.00) | 2.6 | | | | | 2.6 | | | |
| 7.8 | 0.6 | 0.2 | 8.6 | Sub-total | 10.2 (80.91) | 10.2 | | | | | 10.2 | | | |
| | | | | CHAGRIN RIVER | | | | | | | | | | |
| --- | --- | 0.1 | 0.1 | Upper Area | 2.2 (17.77) | 2.2 | | | | | 2.2 | | | |
| --- | --- | --- | --- | Middle Area | --- | | | | | | | | | |
| 0.6 | 0.4 | 0.1 | 1.1 | Lower Area | 3.9 (30.72) | 3.1 | | 0.8 | | | 3.9 | | | |
| 0.6 | 0.4 | 0.2 | 1.2 | Sub-total | 6.1 (48.49) | 5.3 | | 0.8 | | | 6.1 | | | |
| | | | | CUYAHOGA RIVER | | | | | | | | | | |
| --- | --- | 0.3 | 0.3 | Upper Area | 0.8 ( 6.77) | 0.8 | | | | | 0.8 | | | |
| --- | 11.0 | 2.5 | 13.5 | Middle Area | 24.5 (194.57) | 24.5 | | | | | 24.5 | | | |
| 28.7 | --- | 0.1 | 28.8 | Lower Area | 24.3 (192.38) | 24.3 | | | | | 24.3 | | | |
| 28.7 | 11.0 | 2.9 | 42.6 | Sub-total | 49.6 (393.72) | 49.6 | | | | | 49.6 | | | |
| | | | | LAKE ERIE | | | | | | | | | | |
| 47.6 | --- | --- | 47.6 | Sub-total | 34.1 (270.07) | | | 34.1 | | | 34.1 | | | |
| 84.7 | 12.0 | 3.3 | 100.0 | GRAND TOTAL | 100.0 (793.19) | 65.1 | | 34.9 | | | 100.0 | | | |
| Total of these three categories equals 100%. | | | * Figures in parentheses indicate average flow in MGD of domestic and compatible industrial wastes. (H&E revised flow estimates for 2020) | | | Total of these five categories equals 100%. | | | | | Total of these four categories equals 100%. | | | |

State of Ohio Standards

## FORMULATION PLAN 9
## NDCP-FEDERAL STANDARDS - COMBINATION LAND/WATER-BASED

### PLAN DESCRIPTION

Formulation Plan 9 has been developed for the Cleveland-Akron Three Rivers Basin using techniques suggested by other investigators.* Massive regionalization of treatment facilities is one feature represented. A minimum number of plant sites is utilized. Another alternate feature investigated is the use of aerated lagoons for secondary treatment in conjunction with the land-based plants.

The western land treatment management area will include aerated lagoons for secondary treatment of the domestic, industrial, combined and separate storm runoff carried by the Effluent Transmission Tunnel. Four of the existing shoreline plants, which are load points, will be converted to plants providing only preliminary treatment. The remainder of the shoreline plants will be abandoned and the plant sites converted to public use.

The Upper Cuyahoga Basin, including Burton and Middlefield areas, will include a regional land-based treatment system to provide for low flow augmentation of the Upper Cuyahoga River, above Lake Rockwell.

Sludge handling from the shoreline plants and Cleveland Southerly is to Harrison County strip-mined areas via the existing pipeline right-of-way. Sludge disposal from the advanced wastewater treatment plants is by incineration with ash disposal to land-fill sites.

Formulation Plan 9 is illustrated on Drawing P-9, for the year 2020, and on a figure in the General Section which shows the outlying

* Consultants for the Chicago-SELM Wastewater Management Study.

land management area and Tunnel. Schematic Flow Diagrams 2, 3, 5 and 6 illustrate design concepts. A summary plan description is given in Table 9-A for the municipal-industrial, combined sewage conveyance and treatment. In Table 9-B a summary description is given for storm runoff storage, conveyance and treatment.

## WASTEWATER

To accomplish regionalization under this plan, long interceptors will serve the Three Rivers Basin service area. These interceptors will collect domestic, industrial waste flows and stormwater runoff from detention storage basins. The stormwater will be released or pumped into the interceptors during off-peak hours when excess capacity is available in the interceptors and in the treatment plants.

## SLUDGE DISPOSAL

Several basic methods of sludge disposal are proposed in Plan 9.

The method used with advanced wastewater treatment plants consists of incineration and land-fill. This method will be used at New Kent, Akron, Chagrin Falls, North Olmsted, and Southerly.

The second method is to allow the secondary sludge to be oxidized

in the aerated lagoons. Some sludge accumulation will occur in the facultative lagoons and must be periodically disposed of. Disposal for these plants (Hiram Rapids, Randolph and Western Ohio) is by land application of the sludges.

REUSE OPPORTUNITIES

A wide range of reuse opportunities as described in the General Section of this report is applicable to Plan 9 because of the "combination nature of the plan".

The only restriction on reuse as a result of this plan would relate to potential uses along the tunnel route which would require a relatively high quality water. The tunnel would transmit only primary treated sewage which might not be acceptable for many industrial uses.

Return flow to the Upper Cuyahoga, to the Middle Cuyahoga at New Kent and Akron, will provide for low-flow augmentation in specific reaches. The Lower Chagrin and Lower Rocky River will also experience low-flow augmentation; however, the Upper Chagrin and Upper Rocky River will tend towards water deficiencies. The Cleveland Southerly plant will provide extensive opportunities for reuse of the effluent, and will contribute significantly towards maintaining the lower reaches of the Cuyahoga as a flowing stream.

This plan has identified significant land areas in western Ohio to serve municipalities outside of the Three Rivers Basin, including Sandusky and Toledo. This plan also contemplates major new power plant construction at the effluent storage reservoirs, these power plants

generally being situated in optimum areas relative to long-term power demands and network system planning.

The return flow from the irrigated lands in western Ohio would be distributed to western Ohio streams in a manner consistent with the northwestern Ohio water plan. Lands selected for irrigation in western Ohio fall into a category designated by the Great Lakes Basin Commission as having urgent needs for drainage and generally being water deficient.

## REGIONALIZATION

In this discussion "regionalization" is connotated to mean a reduction in number of treatment plants, rather than the objective of regionalizing planning and management. The reduction in number of plants would result in increasing lengths and sizes of transmission conduits and in more "gallon-miles" of waste flow movement.

Since sanitary sewage is an unstable mixture including oxygen-demanding solids, it can become septic during transportation. Rather than treat septic sewage or risk corrosion of sewers, the designs provide for sewage aeration stations along the transmission sewer lines. These would be located at points where the dissolved oxygen sag curve approaches zero and would raise the dissolved oxygen concentration to approximately 6 mg/liter.

ATTACHMENT C

U. S. ARMY CORPS OF ENGINEERS
CLEVELAND-AKRON THREE RIVERS WATERSHED
WASTEWATER MANAGEMENT
SURVEY SCOPE STUDY

# FORMULATION TECHNICAL REPORT

## PART II

## SELECTED PLANS

MARCH 1973

PREPARED BY
WRIGHT-McLAUGHLIN ENGINEERS
DENVER COLORADO

UNDER CONTRACT NO.: DACW49-72-C-0051

TABLE 2-A

MUNICIPAL-INDUSTRIAL DESIGN DATA FOR 2020

| Plant Name | Size | Area Served | Drainage Basins | Comments, Munic.-Indust. Land Treatment Acres | Sludge |
|---|---|---|---|---|---|
| **Chagrin River Basin** | | | | | |
| Chagrin E. Branch | 1.95 S | Chardon Twp, upper E. Branch above Kirtland Hills. Phase out Wilder Mobile Home STP. | | 438 acres land treatment area | Ag |
| (Cleveland Easterly) | (6.5) S | Chagrin R. from north of Lake County Line to Griswold Cr. includes Pepper Pike area and Mayfield Heights. Phase out Woodbran Corp., Pepper Pike Creek Country Club, Pepper Hills, Moreland Hills STP's. | | Out-of-basin | (Sm) |
| Willoughby Eastlake | 22.27 S | Eastlake, Willoughby, Timberlake, Lakeline, lower portion Chagrin basin. Phase out Willoughby Hills, Willow Hills Estates | | 4454 acres for land treatment via the Effluent Transmission Tunnel to West-Central Ohio. | Sm |
| **Upper Cuyahoga River Basin** | | | | | |
| Chardon | .20 S | Southern portion of Chardon. Phase out Nader's Trailer Park STP. | | 30 acres for land treatment to the southeast. | Ag |
| E. Claridon | .48 S | West of East Branch Reservoir, including Claridon and East Claridon. | | 108 acres for land treatment southwest of the plant. | Ag |
| Butternut Creek | 1.17 S | Butternut Creek watershed including Lake Aquilla, portion of Claridon Twp. Phase out Jacques Mobile Home Park, Plymouth Acres, Geauga Community Hospital STP's. | | 263 acres for land treatment to the south. | Ag |
| Middlefield | 2.70 S | Middlefield area. Phase out Middlefield Trailer Park. | | 607 acres for land treatment east of the plant. | Ag |
| Burton | .91 S | Burton, Burton Twp. Phase out Burton City, Bromwood Hills STP's. | | 205 acres for land treatment southeast of the plant | Ag |

TABLE 2-A

MUNICIPAL-INDUSTRIAL DESIGN DATA FOR 2020

| Plant Name | Size | Area Served | Drainage Basins | Comments, Munic.-Indust. Land Treatment Acres | Sludge |
|---|---|---|---|---|---|
| **Upper Cuyahoga River Basin** | | | | | |
| Troy Twp. | .47 S | Welshfield area including portions of Troy Twp. | | 106 acres for land treatment. | Ag |
| Auburn Twp. | .84 S | Auburn Center, Auburn Corners, Auburn Twp West of Ladue Reservoir. | | 189 acres for land treatment to the west near Bridge Creek. | Ag |
| Mantua | .86 S | Mantua area, Mantua Twp. | | 194 acres for land treatment to the south of the plant. | Sm |
| Shalersboro | 2.0 S | Shalersville Twp, portion of Streetsboro. Phase out Triple-B Trailer Park, Shalersville #1, Shalersville #2, Streetsboro #2 STP's. | | 450 acres for land treatment southwest of the plant. | Ag |
| Randolph | .75 S | Randolph Twp. Phase out Randolph Trailer Park STP. | | 169 acres for land treatment | Ag |
| Ravenna | 12.34 S | Ravenna, Ravenna Twp, Rootstown Twp. Phase out West Park Mobile Home, Rootstown #1, Sandy Lakes, Valley Hills, Lakeview Gardens, Longfield STP's. | | 2777 acres for land treatment northeast of Lake Rockwell | Sm |
| New Kent | 28.95 S | Plum Creek, Fish Creek, main stem Cuyahoga to Twin Lakes, Breakneck Cr. to Brady Lake, Franklin Twp. Brimfield Twp, portion of Stow, Munroe Falls Phase out Field Local School, Brimfield, Tallmadge, Renee Estates, Stow-Kent, Kent Rhodes, Franklin, Twin Lakes. Kent STP. | | 6514 acres for land treatment southeast of Kent. | Sm |
| Akron | 149.67 S | Present area and area tributary to Hudson Twp 6 Bath Twp. Suffield Twp. Richfield Twp, Northampton Twp, Cuyahoga Falls, Silver Lake, Mogadore, portion of Stow, Fairlawn, Munroe Falls, Tallmadge, Lakemore, Springfield. Phase out General Motors, Granger Lakes, Revere Local School, Ohio Twenty-One Corp STP's. | | 29380 acres for land treatment via the Eff. Transmission Tunnel to West central Ohio. | Sm |

TABLE 2 -B
STORM RUNOFF DESIGN DATA FOR 2020

| Urban Storm Basin | 2020 1-Year Storm (MG) | 2020 Annual Runoff (MG) | Det'n. Stor. Basin (MG) | Rate of Release (MGD) | Facility Name | Winter Storage Basin (MG) | Land Treat-ment Area (Acres) | Return Flow to | Comments |
|---|---|---|---|---|---|---|---|---|---|
| CU-45 | 19 | 262 | 19 | 3.2 | SWTP # 93 | | | Mud Brook | |
| CU-46 | 10 | 142 | 10 | 1.17 | SWTP # 94 | | | Cuyahoga R. | |
| CU-47 | 49 | 690 | 49 | 8.17 | SWTP # 95 | | | Cuyahoga R. | |
| CU-48 | 18 | 296 | 12 | 366 | SWTP # 96 | | | Cuyahoga R. | |
| CU-49 | 14 | 222 | 14 | 2.17 | SWTP # 97 | | | Cuyahoga R. | |
| CU-50 | 63 | 905 | 63 | 10.5 | SWTP # 98 | | | Cuyahoga R. | |
| CU-51 | 60 | 858 | 60 | 10 | SWTP # 99<br>SWTP # 99a | | | Cuyahoga R.<br>Breakneck Cr. | |
| CU-52 | 17 | 249 | 17 | 2.83 | SWTP # 100 | | | Breakneck Cr. | |
| CU-53 | 45 | 775 | 45 | 7.5 | SWTP # 101 | | | Breakneck Cr. | |
| CU-54 | 39 | 551 | 39 | 6.5 | SWTP # 102 | | | Cuyahoga R. | |
| CU-55 | 25 | 495 | 17 | 366 | SWTP # 96 | | | Cuyahoga R. | |

TABLE 2-B
STORM RUNOFF DESIGN DATA FOR 2020

| [illegible] | 2020 1-Year Storm (MG) | 2020 Annual Runoff (MG) | Det'n. Stor. Basin (MG) | Rate of Release (MGD) | Facility Name | Winter Storage Basin (MG) | Land Treatment Area (Acres) | Return Flow to | Comments |
|---|---|---|---|---|---|---|---|---|---|
| CU-56 | 35 | 656 | 23 | 366 | SWTP # 96 | | | Cuyahoga R. | |
| CU-57 | 17 | 260 | 17 | 2.83 | SWTP # 103 | | | Cuyahoga R. | |
| CU-58 | 41 | 592 | 41 | 6.83 | SWTP # 99 | | | Cuyahoga R. | |
| CU-59 | 30 | 585 | 30 | 5 | SWTP # 104 | | | Ohio R. Basin | |
| CU-60 (c) | 33 | 660 | 22 | 233 | SWTP # 105 | 274* | 357 | W. Ohio | |
| CU-61 (c) | 41 | 755 | 26 | 85 | SWTP # 105<br>SWTP # 105a | 313* | 408 | W. Ohio | |
| CU-62 | 38 | 656 | 24 | 154 | SWTP # 106 | | | Little Cuyahoga R. | |
| CU-63 | 18 | 333 | 16 | 125 | SWTP # 107 | | | Ohio R. Basin | |
| CU-64 (c) | 44 | 866 | 26 | 90 | SWTP # 108<br>SWTP # 108a<br>SWTP # 109 | 359* | 468 | W. Ohio | |
| CU-65 (c) | 8 | 172 | 7 | 53 | SWTP # 109 | 71* | 93 | W. Ohio | |
| CU-66 | 37 | 643 | 23 | 153 | SWTP # 110 | | | Little Cuyahoga R. | |

* Winter storage increment at Western Ohio Basins prior to Land Treatment.

TABLE 2-B
STORM RUNOFF DESIGN DATA FOR 2020

| Urban Storm Basin | 2020 1-Year Storm (MG) | 2020 Annual Runoff (MG) | Det'n. Stor. Basin (MG) | Rate of Release (MGD) | Facility Name | Winter Storage Basin (MG) | Land Treat-ment Area (Acres) | Return Flow to | Comments |
|---|---|---|---|---|---|---|---|---|---|
| CU-67 | 23 | 344 | 22 | 270 | SWTP # 111 | | | Little Cuyahoga R. | |
| CU-68 | 25 | 496 | 16 | 56 | SWTP # 112 | | | Ohio R. Basin | |
| CU-69 | 22 | 349 | 15 | 471 | SWTP # 113 | | | Little Cuyahoga R. | |
| CU-70 | 81 | 1483 | 53 | 471 | SWTP # 113 | | | Little Cuyahoga R. | |
| CU-71 | 16 | 236 | 16 | 270 | SWTP # 111 | | | Little Cuyahoga R. | |
| CU-73 | 4 | 70 | 4 | .67 | SWTP # 114 | | | Cuyahoga R. | |
| CU-74 | 8 | 123 | 8 | 1.33 | SWTP # 114 | | | Cuyahoga R. | |
| CU-75 | 12 | 176 | 12 | 2 | SWTP # 115 | | | Bridge Cr. | |
| CU-76 | 4 | 58 | 4 | .67 | SWTP # 115 | | | Bridge Cr. | |
| CU-77 | 9 | 132 | 9 | 1.5 | SWTP # 116 | | | Cuyahoga R. | |
| CU-78 | 15 | 215 | 15 | 2.5 | SWTP # 117 | | | Tare Cr. | |

TABLE 2-B

STORM RUNOFF DESIGN DATA FOR 2020

| Urban Storm Basin | 2020 1-Year Storm (MG) | 2020 Annual Runoff (MG) | Det'n. Stor. Basin (MG) | Rate of Release (MGD) | Facility Name | Winter Storage Basin (MG) | Land Treatment Area (Acres) | Return Flow to | Comments |
|---|---|---|---|---|---|---|---|---|---|
| CU-79 | 5 | 89 | 5 | .83 | SWTP # 117 | | | Tare Cr. | |
| CU-81 | 2 | 32 | 2 | .33 | SWTP # 117 | | | Tare Cr. | |
| CU-82 | 3 | 36 | 3 | .5 | SWTP # 118 | | | Tare Cr. | |
| CU-83 | 6 | 92 | 6 | 1 | SWTP # 119 | | | Cuyahoga R. | |
| CU-84 | 5 | 73 | 5 | .83 | SWTP # 120 | | | Cuyahoga East Br. | |

TABLE 3-A

MUNICIPAL-INDUSTRIAL DESIGN DATA FOR 2020

| Plant Name | Size 1) | Area Served | Drainage Basins 2) | Comments, Munic.-Indust. Land Treatment Acres | Sludge 3) |
|---|---|---|---|---|---|
| ROCKY RIVER BASIN | | | | | |
| Hinckley | 2.83 T | E. Branch above Healey Cr. confluence to Hinckley Lake. Including Hinckley Twp, and portion of Brunswick. Phase out Hinckley Lake, Beverly Hills, Colony Park, and Brunswick STP's. Upper East Branch north of Summit County Line. | R-24 R-29 R-18 | Discharge to Rocky R. East Br. | Ag |
| Medina Co. | 5.00 T | Area tributary to West Branch south of Medina County Line including portion of Brunswick, Brunswick Hills Twp. | R-28 | Discharge to Plum Creek | Ag |
| New Medina | 10.09 T | Medina City, area tributary to North Branch, portions of Granger Twp, Montville Twp, Medina Twp, York Twp. Area around Lester Reservoir. Phase out existing Medina STP | R-30,32 33,34,35 | Located downstream of existing plant | In |
| Liverpool | 5.00 T | W. Branch south of Medina County to Abbeyville, Liverpool Twp. portion of York Twp. | R-23,25 26,27,31 | Discharge to Rocky R. West Br. | Ag |
| Strongsville | 3.82 T | Phase out North Royalton "A" and "B", Strongsville "B" and "C", upper Baldwin Cr. STP's. | R-14,15 16,17,21 22 | Discharge to Rocky R. East Br. | Ag |
| N. Olmsted | 33.17 T | Local, part of Fairview Park, Columbia Twp, Olmsted Twp, Olmsted Falls including Westview. Phase out Brookpark, Middleburg Hts., Berea, Strongsville "A", Olmsted Falls, Brentwood Estates STP's. | R-6,7,8,9 10,11,12 13,19,20 | Discharge to Rocky R. | In |

1) T = Tertiary

2) Basins discharging to municipal-industrial plants

3) Sm = Strip-mined land reclamation
Ag = Agricultural land application
In = Incineration, ash to landfill

**TABLE 3-A**

**MUNICIPAL-INDUSTRIAL DESIGN DATA FOR 2020**

| Plant Name | Size | Area Served | Drainage Basins | Comments, Munic.-Indust. Land Treatment Acres | Sludge |
|---|---|---|---|---|---|
| Lakewood | 21.00 T | Local, portion of Cleveland, Rocky R. below North Olmsted. | R-3,4,5 | Discharge to Rocky R. | In |
| **CHAGRIN RIVER BASIN** | | | | | |
| Haven Road | 3.52 T | Upper W. Branch below Bass Lake including Fowler's Mill, portion of Munson Twp. Phase out Notre Dame Educ. Center STP. Newbury Center area of Newbury Twp. Phase out Newbury Local School STP. | CHN-35 CHN-36 | Discharge to Chagrin R. | Sm |
| Silver Creek | 3.40 T | W. Branch above Silver Creek confluence to Munson Twp, Russell Park, Chesterland, portion of Chester Twp, Russell Twp. Phase out Opalaka, West Geauga Local School, Belle Vernon Acres, Silver Creek School District, Russell Park STP's. | CHN-16,17 18,19,20, 21,22,25 | Discharge to Chagrin R. West Br. | Sm |
| Aurora Central | 2.98 T | Aurora, portion of Mantua Twp, Aurora Twp. Phase out Robin's Trailer Park STP. | CHN-30,31 32,33,34 | Discharge to Aurora Br. | Sm |
| McFarland Creek | 4.29 T | McFarland Creek watershed including Tanglewood, Ravenwood, South Russell, portion of Bainbridge, Bainbridge Twp. Phase out Tanglewood, Pilgrim Village, South Russell, Ravenwood, Knowles Ind. Park STP's. | CHN-24,28, 29 | Discharge to Aurora Br. | In |
| Chagrin Falls | 3.58 T | Local, Bentleyville, Moreland Hills, portions of Russell Twp, Chagrin Falls Twp, Russell Twp. Bainbridge Twp. Phase out Wenhaven, Solon N. E., Scarsdale Estates STP's. | CHN-23,26, 27 | Discharge to Chagrin R. West Br. | In |

## FORMULATION PLAN 4, NDCP-FEDERAL STANDARDS-ALL LAND TREATMENT

### PLAN DESCRIPTION

This land treatment plan is built upon Formulation Plan 2. Full land treatment of all storm runoff has been included. The reader is referred to Plan 2.

Formulation Plan 4 proposes complete land treatment of sanitary sewage, compatible industrial wastes and urban storm runoff after secondary biological treatment processes. Irrigation areas used are agricultural lands, or potential agricultural land, in the Three Rivers Basin, coupled with the large areas of agricultural land lying west of Cleveland in the Lake Erie drainage basin. Sludge disposal is via two pipelines to strip-mined lands for the larger metropolitan plants, and by local land application for smaller plants.

The basic philosophy incorporated into this Plan 4 for separated storm runoff treatment is that, when practical, the storm runoff is treated in the basin of origin, so as to alter the natural hydrological regime as little as possible. Storm runoff in the Cleveland and Akron Metropolitan Areas is conveyed to the western land treatment management area after receiving secondary treatment.

Plan 4 assumes all land treatment and is intended to meet the criteria requirements for a NDCP-Federal Standards Plan. The water quality design criteria are the anticipated standards to meet the national goal of no discharge of constituents at critical levels.

Formulation Plan 4 is illustrated on Drawing P-4 for the year

2020. Schematic Flow Diagrams 5 and 6 illustrate typical design concepts. A summary plan description is given in Table 4-A for the municipal and industrial wastewater conveyance and treatment. In Table 4-B a summary description is given for storm runoff storage, conveyance and treatment.

## WASTEWATER

Municipal wastewater is treated in conventional secondary biological-type facilities. Separate urban storm runoff is generally treated in its basin of origin on land either by spray irrigation or overland runoff techniques.

The Drawing P-4 shows underground mined/surface storage for combined stormwater. This storage is shown schematically for the full one-year frequency storm. Combined sewage would be evacuated in approximately three days for treatment and then for discharge to the Effluent Transmission Tunnel.

In the Cleveland Easterly Basin a new treatment plant with a capacity of approximately 159 MGD is needed for the combined storm sewage. This new plant would provide primary treatment only. It would function only during and after the larger storm when Cleveland Easterly would be overtaxed.

The Cleveland Westerly Basin would have a primary plant increment added with a capacity of 29 MGD to treat combined sewage inflow which exceeded the capacity of the Westerly Plant.

The Akron Plant would be capable of treating combined sewer flows for the one-year frequency in approximately three days, using peaking capacity during off-peak hours; however, a primary increment would be needed with a capacity of about 41 MGD for excess flows originating from the separate storm runoff.

This plan for combined sewage can be expanded to handle the 5 or 10-year frequency storm if future needs change.

Combined sewage receiving only primary treatment in the Metropolitan areas will receive supplemental treatment at the land management area in the storage reservoir.

Industrial wastes receive pretreatment so as not to upset the biological processes. The pretreatment is less than that needed before a conventional tertiary facility since the land provides storage capacity for considerable amounts of constituents.

## SLUDGE DISPOSAL

Sludge disposal in Formulation Plan 4 is by two methods: (1) strip-mine application and (2) in-basin agricultural application.

Those plants utilizing the strip-mine application of sludge disposal are in the general vicinity of the existing 10-inch pipeline, (and along the Effluent Transmission Tunnel), now terminating in Harrison County. The sludge piped to this point is used to renovate strip-mined lands in Harrison and neighboring counties. Treatment plants using strip-mine application of sludge disposal are:

| | |
|---|---|
| Rocky River | Willoughby-Eastlake |
| North Olmsted | Mantua |
| Lakewood | Ravenna |
| Southerly | New Kent |
| Westerly | Akron |
| Easterly | Tinkers Creek |
| Euclid | Silver Creek |
| McFarland Creek | Aurora Central |
| Chagrin Falls | Auburn |
| Shalersboro | |

The remaining treatment plants proposed for Plan 4 dispose of sludge by in-basin agricultural applications. They are plants usually removed from the sludge pipeline and have available land nearby for sludge treatment.

Land treatment areas within the Three Rivers Basin will receive sludge applied along with the irrigation water in most cases. Where nutrient loads may become too high because of heavier hydraulic application rates, sludge will be applied to other, but existing farmland, separately from the irrigation applications, by trucking, spreading, and discing. Application rates will be in accordance with crop and soil needs. Sale of such sludge to agriculture may be feasible.

## REUSE OPPORTUNITIES

The full range of reuse opportunities are essentially available

for this plan, as described in the General Section of this report. However, industrial reuse is limited to Cleveland Southerly because of the extensive out-of-basin transport of water from Akron and the Cleveland Metropolitan plants. Upper and middle basin land treatment return flow is available for stream augmentation of low flows in the Three Rivers Basin.

TABLE 4 -A

MUNICIPAL-INDUSTRIAL DESIGN DATA FOR 2020

| Plant Name | Size 1) | Area Served | Drainage Basins 2) | Comments, Munic.-Indust. Land Treatment Acres | Sludge 3) |
|---|---|---|---|---|---|
| **ROCKY RIVER BASIN** | | | | | |
| Upper East Branch | 1.11 S | Upper East Branch north of Summit County Line. | R-18 | 167 acres land treatment, golf courses and adjacent ground, northeast of the plant. | Ag |
| Hinckley | 1.72 S | E. Branch above Healey Cr. confluence to Hinckley Lake. Including Hinckley Twp, and portion of Brunswick. Phase out Hinckley Lake, Beverly Hills, Colony Park, and Brunswick STP's. | R-24 | 258 acres land treatment to the southwest is used for effluent disposal. The adjacent area is used for the Medina County Plant effluent. | Ag |
| Medina County | 5.00 S | Area tributary to West Branch south of Medina County Line including portion of Brunswick, Brunswick Hills Twp. | | 750 acres for land treatment | Ag |
| New Medina | 9.49 S | Medina City, area tributary to North Branch, portions of Granger Twp, Montville Twp, Medina Twp, York Twp. Phase out existing Medina STP | | 1424 acres for land treatment northwest of Medina. Adjacent area is used for the plant. | Ag |
| Mallet Creek | .60 S | Area around Lester Reservoir. | | 90 acres for land treatment northeast of the plant. Adjacent area is used for the Medina Plant. | Ag |
| Liverpool | 5.00 S | W. Branch south of Medina County to Abbeyville, Liverpool Twp. portion of York, York Twp. | | 750 acres for land treatment west of the plant. | Ag |

1) S = Secondary
T = Tertiary

2) Basins discharging to municipal-industrial plants.

3) Sm = Strip-mined land reclamation
Ag = Agricultural land application
In = Incineration, ash to landfill.

TABLE 4-A

MUNICIPAL-INDUSTRIAL DESIGN DATA FOR 2020

| Plant Name | Size | Area Served | Drainage Basins | Comments, Munic.-Indust. Land Treatment Acres | Sludge |
|---|---|---|---|---|---|
| N. Olmsted | 36.99 S | Local, part of Fairview Park, Columbia Twp. Olmsted Twp, Olmsted Falls including Westview, Phase out Brookpark, Middleburg Hts., Berea, Strongsville "A", Olmsted Falls, Brentwood Estates STP's. Phase out North Royalton "A" and "B", Strongsville "B" and "C", upper Baldwin Cr. STP's. | R-22,21,17 16,15,14 13,10,9 8,7,6 | 7398 acres for land treatment via the Eff. Transmission Tunnel to West-Central Ohio. | Sm |
| Lakewood | 21.00 S | Local, portion of Cleveland, Rocky R. below North Olmsted. | R-3, LE-8 | 4200 acres for land treatment via the Eff. Transmission Tunnel to West-Central Ohio. | Sm |
| **CHAGRIN RIVER BASIN** | | | | | |
| Haven Road | 3.52 S | Upper W. Branch below Bass Lake including Fowler's Mill, portion of Munson Twp, Phase out Notre Dame Educ. Center STP. Newbury Center area of Newbury Twp. Phase out Newbury Local School STP. | | 528 acres for land treatment to the Northwest and East. | Ag |
| Silver Creek | 3.40 S | W. Branch above Silver Creek confluence to Munson Twp, Russell Park, Chesterland, portion of Chester Twp, Russell Twp. Phase out Opalaka, West Geauga Local School, Belle Vernon Acres, Silver Creek School District, Russell Park STP's. | CHN-16,17 20,21,22 | 765 acres for land treatment at the head of Silver Creek, integrated with the planned industrial development. | Sm |
| Aurora Central | 2.98 S | Aurora, portion of Mantua Twp, Aurora Twp. Phase out Robin's Trailer Park STP. | CHN-30,32 33,34 | 671 acres for land treatment on the Chagrin-Cuyahoga Basins Boundary. Adjacent area is used for the Chagrin Falls and McFarland Creek Plant effluents. | Sm |

TABLE 4-A

MUNICIPAL-INDUSTRIAL DESIGN DATA FOR 2020

| Plant Name | Size | Area Served | Drainage Basins | Comments, Munic.-Indust. Land Treatment Acres | Sludge |
|---|---|---|---|---|---|
| CHAGRIN RIVER BASIN (Cont.) | | | | | |
| McFarland Creek | 4.29 S | McFarland Creek watershed including Tanglewood, Ravenwood, South Russell, portion of Bainbridge, Bainbridge Twp, Phase out Tanglewood, Pilgrim Village, South Russell, Ravenwood, Knowles Ind. Park STP's. | CHN-24,28 | 965 acres for land treatment as that one proposed for the Aurora Plant. Adjacent area is used for the Chagrin Falls and McFarland Creek Plant effluents. | Sm |
| Chagrin Falls | 3.58 S | Local, Bentleyville, Moreland Hills, portions of Russell Twp, Chagrin Falls Twp. Russell Twp. Bainbridge Twp. Phase out Wenhaven, Solon N. E., Scarsdale Estates STP's. | CHN-23,26 27 | 806 acres for land treatment as that one proposed for the Aurora Plant. Adjacent area is used for the Chagrin Falls and McFarland Creek Plant Effluents. | Sm |
| Chagrin East Branch | 1.95 S | Chardon Twp, upper E. Branch above Kirtland Hills. Phase out Wilder Mobile Home STP. | | 439 acres for land treatment along stream flatlands. | Ag |
| (Cleveland Easterly) | (6.50)S | Chagrin R. from north of Lake County Line to Griswold Cr. includes Pepper Pike area and Mayfield Heights. Phase out Woodbran Corp., Pepper Pike Creek Country Club, Pepper Hills, Moreland Hills STP's. | | Out-of-basin | (Sm) |
| Willoughby Eastlake | 22.27 S | Eastlake, Willoughby, Timberlake, Lakeline, lower portion Chagrin basin. Phase out Willoughby Hills, Willow Hills Estates. | CHN-1,2,3, 4,5,6,11 | 4454 acres for land treatment via the Eff. Transmission Tunnel to West-Central Ohio. | Sm |

TABLE 4 -B
STORM RUNOFF DESIGN DATA FOR 2020

| Urban Storm Basin | 2020 1-Year Storm (MG) | 2020 Annual Runoff (MG) | Det'n. Stor. Basin (MG) | Rate of Release (MGD) | Facility Name | Winter Storage Basin (MG) | Land Treat-ment Area (Acres) | Return Flow to | Comments |
|---|---|---|---|---|---|---|---|---|---|
| R-24 | 23 | 345 | 55.2 | 2.30 | Hinckley | 80 | 141 | Rocky R. North Br. | |
| R-25 | 17 | 250 | 17. | 5.67 | SWTP # 8 | 58 | 61 | Rocky R. West Br. | |
| R-26 | 4 | 50 | 4. | 1.33 | SWTP # 7 | 12 | 12 | Rocky R. West Br. | |
| R-27 | 15 | 218 | 15. | 5.00 | SWTP # 6 | 51 | 53 | Rocky R. West Br. | |
| R-28 | 62 | 896 | 62. | 20.67 | SWTP # 2 | 209 | 220 | Rocky R. North Br. | |
| R-29 | 11 | 169 | 11. | 3.67 | SWTP # 1 | 39 | 41 | Rocky R. East Br. | |
| R-30 | 7 | 93 | 7. | 2.33 | SWTP # 3 | 22 | 23 | Rocky R. North Br. | |
| R-31 | 4 | 68 | 4. | 1.33 | SWTP # 5 | 16 | 17 | Rocky R. West Br. | |
| R-32 | 21 | 301 | 21. | 7.00 | SWTP # 5 | 70 | 74 | Rocky R. West Br. | |
| R-33 | 4 | 52 | 4. | 1.33 | SWTP # 3 | 12 | 13 | Rocky R. North Br. | |
| R-34 | 12 | 175 | 12. | 4.00 | SWTP # 4 | 41 | 43 | Rocky R. West Br. | |
| R-35 | 20 | 300 | 20. | 6.67 | SWTP # 4 | 70 | 74 | Rocky R. West Br. | |

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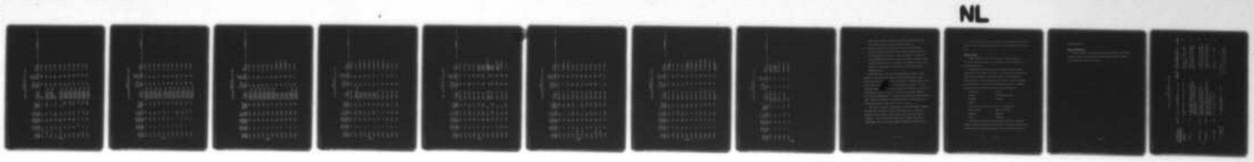

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TABLE 4 -B
STORM RUNOFF DESIGN DATA FOR 2020

| Urban Storm Basin | 2020 1-Year Storm (MG) | 2020 Annual Runoff (MG) | Det'n. Stor. Basin (MG) | Rate of Release (MGD) | Facility Name | Winter Storage Basin (MG) | Land Treat-ment Area (Acres) | Return Flow to | Comments |
|---|---|---|---|---|---|---|---|---|---|
| CU-1 (c) | 33 | 644 | 33. | 11. | SWTP | 267 | 348 | W. Ohio | |
| CU-2 (c) | 62 | 1220 | 62. | 20.67 | Cleveland Southerly STP | 506 | 659 | W. Ohio | |
| CU-3 (c) | 45 | 835 | 45. | 15. | Cleveland Southerly STP | 347 | 451 | W. Ohio | |
| CU-4 | 304 | 5573 | 891.7 | 37.17 | SWTP | 2313 | 3009 | W. Ohio | |
| CU-5 (c) | 162 | 2967 | 162. | 54. | Cleveland Southerly STP | 1231 | 1602 | W. Ohio | |
| CU-6 | 46 | 728 | 116. | 4.86 | Cleveland Southerly STP | 302 | 393 | W. Ohio | |
| CU-7 | 42 | 598 | 95.7 | 3.99 | Cleveland Southerly STP | 248 | 323 | W. Ohio | |
| CU-8 | 98 | 1386 | 221.7 | 9.24 | Cleveland Southerly STP | 575 | 748 | W. Ohio | |
| CU-9 | 7.5 | 112 | 17.9 | .75 | Cleveland Southerly STP | 47 | 60 | W. Ohio | |
| CU-10 | 11 | 162 | 25.9 | 1.08 | Cleveland Southerly STP | 67 | 87 | W. Ohio | |
| CU-11 | 27 | 432 | 69.1 | 2.88 | Cleveland Southerly STP | 179 | 233 | W. Ohio | |

TABLE 4 -B
STORM RUNOFF DESIGN DATA FOR 2020

| Urban Storm Basin | 2020 1-Year Storm (MG) | 2020 Annual Runoff (MG) | Det'n. Stor. Basin (MG) | Rate of Release (MGD) | Facility Name | Winter Storage Basin (MG) | Land Treat-ment Area (Acres) | Return Flow to | Comments |
|---|---|---|---|---|---|---|---|---|---|
| CU-12 | 3 | 62 | 9.9 | .41 | Cleveland Southerly STP | 26 | 33 | W. Ohio | |
| CU-13 | 41 | 595 | 95.2 | 3.97 | Cleveland Southerly STP | 247 | 321 | W. Ohio | |
| CU-14 | 35 | 500 | 80. | 3.34 | Cleveland Southerly STP | 208 | 270 | W. Ohio | |
| CU-15 | 4 | 57 | 9.1 | .38 | Cleveland Southerly STP | 24 | 31 | W. Ohio | |
| CU-16 | 13 | 196 | 31.4 | 1.31 | Cleveland Southerly STP | 81 | 106 | W. Ohio | |
| CU-17 | 10 | 150 | 24. | 1.00 | Cleveland Southerly STP | 62 | 81 | W. Ohio | |
| CU-18 | 5 | 73 | 11.7 | .49 | Cleveland Southerly STP | 30 | 39 | W. Ohio | |
| CU-19 | 44 | [illegible] | 100.8 | 4.20 | Cleveland Southerly STP | 261 | 340 | W. Ohio | |
| CU-20 | 15 | 221 | 35.4 | 1.47 | Cleveland Southerly STP | 92 | 119 | W. Ohio | |
| CU-21 | 11 | 164 | 26.3 | 1.09 | Cleveland Southerly STP | 68 | 89 | W. Ohio | |
| CU-22 | 7 | 110 | 17.6 | .73 | Cleveland Southerly STP | 46 | 59 | W. Ohio | |

TABLE 4-B
STORM RUNOFF DESIGN DATA FOR 2020

| Urban Storm Basin | 2020 1-Year Storm (MG) | 2020 Annual Runoff (MG) | Det'n. Stor. Basin (MG) | Rate of Release (MGD) | Facility Name | Winter Storage Basin (MG) | Land Treat-ment Area (Acres) | Return Flow to | Comments |
|---|---|---|---|---|---|---|---|---|---|
| CU-23 | 8 | 120 | 19.2 | .80 | Cleveland Southerly STP | 50 | 65 | W. Ohio | |
| CU-24 | 26 | 373 | 59.7 | 2.49 | Cleveland Southerly STP | 155 | 201 | W. Ohio | |
| CU-25 | 33 | 492 | 78.7 | 3.28 | Cleveland Southerly STP | 204 | 266 | W. Ohio | |
| CU-26 | 9 | 134 | 21.4 | .89 | Cleveland Southerly STP | 56 | 72 | W. Ohio | |
| CU-27 | 22 | 316 | 50.6 | 2.11 | Cleveland Southerly STP | 131 | 171 | W. Ohio | |
| CU-28 | 8 | 122 | 19.5 | .81 | Cleveland Southerly STP | 51 | 66 | W. Ohio | |
| CU-29 | 27 | 391 | 62.6 | 2.61 | Tinkers Cr. STP | 106 | 240 | Cuyahoga R. | |
| CU-30 | 9 | 130 | 20.8 | .87 | Tinkers Cr. STP | 55 | 80 | Cuyahoga R. | |
| CU-31 | 7 | 105 | 16.8 | .70 | Tinkers Cr. STP | 45 | 64 | Cuyahoga R. | |
| CU-32 | 13 | 178 | 28.5 | 1.19 | Cleveland Southerly STP | 74 | 96 | W. Ohio | |
| CU-33 | 8 | 135 | 21.6 | .90 | Cleveland Southerly STP | 56 | 73 | W. Ohio | |

TABLE 4-B
STORM RUNOFF DESIGN DATA FOR 2020

| Urban Storm Basin | 2020 1-Year Storm (MG) | 2020 Annual Runoff (MG) | Det'n. Stor. Basin (MG) | Rate of Release (MGD) | Facility Name | Winter Storage Basin (MG) | Land Treat-ment Area (Acres) | Return Flow to | Comments |
|---|---|---|---|---|---|---|---|---|---|
| CU-34 | 14 | 198 | 14. | 4.67 | SWTP # 26 | 46 | 49 | Cuyahoga R. | |
| CU-35 | 57 | 836 | 133.8 | 5.58 | Cleveland Southerly STP | 347 | 451 | W. Ohio | |
| CU-36 | 14 | 210 | 33.6 | 1.40 | Tinkers Cr. STP | 89 | 129 | Cuyahoga R. | |
| CU-37 | 14 | 200 | 32. | 1.33 | Tinkers Cr. STP | 85 | 123 | Cuyahoga R. | |
| CU-38 | 9 | 140 | 22.4 | .93 | Tinkers Cr. STP | 60 | 86 | Cuyahoga R. | |
| CU-39 | 21 | 291 | 46.6 | 1.94 | Tinkers Cr. STP | 124 | 179 | Cuyahoga R. | |
| CU-40 | 4 | 58 | 4. | 1.33 | SWTP # 25 | 12 | 14 | Furnace Run | |
| CU-41 | 5 | 74 | 5. | 1.67 | SWTP # 24 | 16 | 18 | Furnace Run | |
| CU-42 | 8 | 108 | 8. | 2.67 | SWTP # 23 | 23 | 26 | Yellow R. | |
| CU-43 | 11 | 167 | 26.7 | 1.11 | Akron STP | 69 | 90 | W. Ohio | |
| CU-44 | 13 | 203 | 32.5 | 1.35 | Akron STP | 84 | 110 | W. Ohio | |

TABLE 4 -B
STORM RUNOFF DESIGN DATA FOR 2020

| Urban Storm Basin | 2020 1-Year Storm (MG) | 2020 Annual Runoff (MG) | Det'n. Stor. Basin (MG) | Rate of Release (MGD) | Facility Name | Winter Storage Basin (MG) | Land Treat-ment Area (Acres) | Return Flow to | Comments |
|---|---|---|---|---|---|---|---|---|---|
| CU-45 | 19 | 262 | 41.9 | 1.75 | Akron STP | 109 | 142 | W. Ohio | |
| CU-46 | 10 | 142 | 22.7 | .95 | Akron STP | 59 | 77 | W. Ohio | |
| CU-47 | 49 | 690 | 110.4 | 4.60 | Akron STP | 286 | 373 | W. Ohio | |
| CU-48 | 18 | 296 | 47.4 | 1.97 | Akron STP | 123 | 160 | W. Ohio | |
| CU-49 | 14 | 222 | 35.5 | 1.48 | Kent STP | 94 | 136 | Feeder Ditch | |
| CU-50 | 63 | 905 | 144.8 | 6.04 | Kent STP | 385 | 556 | Feeder Ditch | |
| CU-51 | 60 | 858 | 60. | 20. | Kent STP<br>SWTP # 18 | 365 | 527 | Breakneck Cr.<br>Feeder Ditch | |
| CU-52 | 17 | 249 | 39.8 | 1.66 | Kent STP | 106 | 153 | Feeder Ditch | |
| CU-53 | 45 | 775 | 45. | 15. | SWTP # 17 | 329 | 476 | Mahoning R. West Br. | |
| CU-54 | 39 | 551 | 39. | 13. | SWTP # 22 | 234 | 338 | Cuyahoga R. | |
| CU-55 | 25 | 495 | 79.2 | 3.30 | Akron STP | 205 | 267 | W. Ohio | |

TABLE 4 -B
STORM RUNOFF DESIGN DATA FOR 2020

| Urban Storm Basin | 2020 1-Year Storm (MG) | 2020 Annual Runoff (MG) | Det'n. Stor. Basin (MG) | Rate of Release (MGD) | Facility Name | Winter Storage Basin (MG) | Land Treat-ment Area (Acres) | Return Flow to | Comments |
|---|---|---|---|---|---|---|---|---|---|
| CU-56 | 35 | 656 | 105. | 4.38 | Akron STP | 272 | 354 | W. Ohio | |
| CU-57 | 17 | 260 | 17. | 5.67 | SWTP # 21 | 111 | 160 | Cuyahoga R. | |
| CU-58 | 41 | 592 | 41. | 13.67 | SWTP # 19 | 252 | 363 | Cuyahoga R. | |
| CU-59 | 30 | 585 | 93.6 | 3.90 | Akron STP | 243 | 316 | W. Ohio | |
| CU-60 (c) | 33 | 660 | 33. | 11. | Akron STP | 274 | 356 | W. Ohio | |
| CU-61 (c) | 41 | 755 | 41. | 13.67 | Akron STP | 313 | 408 | W. Ohio | |
| CU-62 | 38 | 656 | 105. | 4.38 | Akron STP | 272 | 354 | W. Ohio | |
| CU-63 | 18 | 333 | 53.3 | 2.22 | Akron STP | 138 | 180 | W. Ohio | |
| CU-64 (c) | 44 | 866 | 44. | 14.67 | Akron STP | 359 | 468 | W. Ohio | |
| CU-65 (c) | 8 | 172 | 8. | 2.67 | Akron STP | 71 | 93 | W. Ohio | |
| CU-66 | 37 | 643 | 102.9 | 4.29 | Akron STP | 267 | 347 | W. Ohio | |

TABLE 4 -B
STORM RUNOFF DESIGN DATA FOR 2020

| Urban Storm Basin | 2020 1-Year Storm (MG) | 2020 Annual Runoff (MG) | Det'n. Stor. Basin (MG) | Rate of Release (MGD) | Facility Name | Winter Storage Basin (MG) | Land Treat-ment Area (Acres) | Return Flow to | Comments |
|---|---|---|---|---|---|---|---|---|---|
| CU-67 | 23 | 344 | 23. | 7.67 | SWTP # 20 | 146 | 211 | Little Cuyahoga R. | |
| CU-68 | 25 | 496 | 79.4 | 3.31 | Akron STP | 206 | 268 | W. Ohio | |
| CU-69 | 22 | 349 | 55.8 | 2.33 | Akron STP | 145 | 188 | W. Ohio | |
| CU-70 | 81 | 1483 | 237.3 | 9.89 | Akron STP | 615 | 801 | W. Ohio | |
| CU-71 | 16 | 236 | 16. | 5.33 | SWTP # 20 | 100 | 145 | Little Cuyahoga R. | |
| CU-73 | 4 | 70 | 4. | 1.33 | SWTP # 15 | 30 | 43 | Cuyahoga R. | |
| CU-74 | 8 | 123 | 8. | 2.67 | SWTP # 15 | 52 | 76 | Cuyahoga R. | |
| CU-75 | 12 | 176 | 28.2 | 1.17 | Auburn STP | 75 | 108 | Bridge Brook | |
| CU-76 | 4 | 58 | 9.3 | .39 | Auburn STP | 25 | 36 | Bridge Brook | |
| CU-77 | 9 | 132 | 21.1 | .88 | Burton STP | 56 | 81 | Cuyahoga R. | |
| CU-78 | 15 | 215 | 34.4 | 1.43 | Middlefield STP | 91 | 132 | Cuyahoga R. East Br. | |

TABLE 4 -B
STORM RUNOFF DESIGN DATA FOR 2020

| Urban Storm Basin | 2020 1-Year Storm (MG) | 2020 Annual Runoff (MG) | Det'n. Stor. Basin (MG) | Rate of Release (MGD) | Facility Name | Winter Storage Basin (MG) | Land Treat-ment Area (Acres) | Return Flow to | Comments |
|---|---|---|---|---|---|---|---|---|---|
| CU-79 | 5 | 89 | 14.2 | .59 | Middlefield STP | 38 | 55 | Cuyahoga R. East Br. | |
| CU-81 | 2 | 32 | 5.1 | .21 | Middlefield STP | 14 | 20 | Cuyahoga R. East Br. | |
| CU-82 | 3 | 36 | 3. | 1. | SWTP # 14 | 15 | 22 | Tare Creek | |
| CU-83 | 6 | 92 | 14.7 | .61 | Burton STP | 39 | 56 | Cuyahoga R. | |
| CU-84 | 5 | 73 | 11.7 | .49 | SWTP | 31 | 45 | Cuyahoga R. | |

middle basin area are the Akron and Cleveland Southerly plants which would be "model" tertiary treatment plants.

c. Shoreline Areas and Lower Basins, where existing wastewater collection systems flow to shoreline sewage treatment plants for direct discharge to Lake Erie. Here, the domestic, industrial and combined sewage would be treated in secondary treatment plants and the effluent would be discharged to the Effluent Transmission Tunnel for transportation to the western Ohio land treatment management area.

Under this plan, using State Standards design criteria, urban separate storm runoff would receive at least sedimentation, microstraining, and disinfection. This would occur in natural channel storm runoff basins where storm sewers did not generally exist. In some instances, vacated treatment plants would be utilized for the urban runoff treatment, as well as rapid infiltration basins where geologic conditions were appropriate. In Metropolitan Cleveland, urban separate storm runoff would generally receive settlement, microstraining and disinfection before release to the river or lake.

The plants, conduits, storage basins, and design layout represent the 2020 year conditions. Return flow consideration, as well as economics, have strongly influenced plant locations and/or type of treatment. The use of multiple storm water retention basins will reduce peak flows and provide streamflow augmentation opportunities.

Provision could also be made to utilize an enlarged land treatment area to include some additional western Ohio communities and for Toledo, Ohio.

SLUDGE DISPOSAL

Sludge disposal in Formulation Plan 6 is by three methods: (1) strip-mine application, (2) incineration and (3) in-basin agricultural application.

Those plants utilizing the strip-mine application of sludge disposal are in the general vicinity of the existing 10-inch pipeline, (and along the Effluent Transmission Tunnel), now terminating in Harrison County. The sludge piped to this point is used to renovate strip-mined lands in Harrison and neighboring counties. Treatment plants using strip-mine application of sludge disposal are:

| | |
|---|---|
| Rocky River | Euclid |
| Lakewood | Willoughby-Eastlake |
| Westerly | Ravenna |
| Easterly | |

Incineration with ash to land-fill is proposed for:

| | |
|---|---|
| North Olmsted | Bedford Heights |
| Southerly | New Kent |
| Akron | Macedonia |

The remaining treatment plants proposed for Plan 6 dispose of sludge by in-basin agricultural applications. They are plants usually removed from the sludge pipeline and have available land nearby for

sludge treatment.

REUSE OPPORTUNITIES

The full range of reuse opportunities as described in the General Section of this report are generally applicable to Plan 6 because of the "combination" nature of the plan.

TABLE 6-A

MUNICIPAL-INDUSTRIAL DESIGN DATA FOR 2020

| Plant Name | Size 1) | Area Served | Drainage Basins 2) | Comments, Munic.-Indust. Land Treatment Acres | Sludge 3) |
|---|---|---|---|---|---|
| ROCKY RIVER BASIN | | | | | |
| Upper East Branch | 1.11 S | Upper East Branch north of Summit County Line. | | 167 acres for land treatment at three local golf courses if desired. | Ag |
| Hinckley | 1.72 S | E. Branch above Healey Cr. confluence to Hinckley Lake. Including Hinckley Twp, and portion of Brunswick. Phase out Hinckley Lake, Beverly Hills, Colony Park, and Brunswick STP's. | | 258 acres for land treatment to the southwest, the Medina County Plant uses an adjacent area. | Ag |
| Medina County | 5.00 S | Area tributary to West Branch south of Medina County Line including portion of Brunswick, Brunswick Hills Twp. | | 750 acres for land treatment to the northeast. The Hinckley Plant uses an adjacent area. | Ag |
| New Medina | 9.49 S | Medina City, area tributary to North Branch, portions of Granger Twp, Montville Twp, Medina Twp, York Twp. Phase out existing Medina STP | | 1424 acres for land treatment located downstream of existing plant. | Ag |
| Mallet Creek | .60 S | Area around Lester Reservoir. | | 90 acres for land treatment locally. | Ag |

1) S = Secondary
T = Tertiary

2) Basins discharging to municipal-industrial plants.

3) In = Incineration
Ag = Agricultural land application
Sm = Strip-mined land reclamation